IMPERIAL COUNTY
AIR POLLUTION CONTROL DISTRICT

August 19, 2016 and August 21, 2016
Exceptional Event Documentation
For the Imperial County PM_{10} Nonattainment Area

FINAL DRAFT

December 11, 2018

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ACRONYM	DESCRIPTIONS
AOD	Aerosol Optical Depth
AQI	Air Quality Index
AQS	Air Quality System
BACM	Best Available Control Measures
BAM 1020	Beta Attenuation Monitor Model 1020
BLM	United States Bureau of Land Management
BP	United States Border Patrol
CAA	Clean Air Act
CARB	California Air Resources Board
CMP	Conservation Management Practice
DCP	Dust Control Plan
DPR	California Department of Parks and Recreation
EER	Exceptional Events Rule
EPA	Environmental Protection Agency
FEM	Federal Equivalent Method
FRM	Federal Reference Method
GOES-W/E	Geostationary Operational Environmental Satellite (West/East)
HC	Historical Concentrations
HYSPLIT	Hybrid Single Particle Lagrangian Integrated Trajectory Model
ICAPCD	Imperial County Air Pollution Control District
INPEE	Initial Notification of a Potential Exceptional Event
ITCZ	Inter Tropical Convergence Zone
KBLH	Blythe Airport
KCZZ	Campo Airport
KIPL	Imperial County Airport
KNJK	El Centro Naval Air Station
KNYL/MCAS	Yuma Marine Corps Air Station
KPSP	Palm Springs International Airport
KTRM	Jacqueline Cochran Regional Airport (aka Desert Resorts Rgnl Airport)
PST	Local Standard Time
MMML/MXL	Mexicali, Mexico Airport
MODIS	Moderate Resolution Imaging Spectroradiometer
MPH	Miles Per Hour
MST	Mountain Standard Time
NAAQS	National Ambient Air Quality Standard
NCAR	National Center for Atmospheric Research
NCEI	National Centers for Environmental Information
NEAP	Natural Events Action Plan
NEXRAD	Next-Generation Radar
NOAA	National Oceanic and Atmospheric Administration
nRCP	Not Reasonably Controllable or Preventable
NWS	National Weather Service

PDT	Pacific Daylight Time
PM_{10}	Particulate Matter less than 10 microns
$PM_{2.5}$	Particulate Matter less than 2.5 microns
PST	Pacific Standard Time
QA/QC	Quality Assured and Quality Controlled
QCLCD	Quality Controlled Local Climatology Data
RACM	Reasonable Available Control Measure
RAWS	Remote Automated Weather Station
SIP	State Implementation Plan
SLAMS	State Local Ambient Air Monitoring Station
SMP	Smoke Management Plan
SSI	Size-Selective Inlet
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UTC	Coordinated Universal Time
WRCC	Western Regional Climate Center

I Introduction

On August 19, 2016 and August 21, 2016, State and Local Ambient Air Monitoring Stations (SLAMS), located in Brawley (AQS Site Code 060250007), Westmorland (AQS Site Code 060254003) and El Centro (AQS Site Code 060251003) California, measured an exceedance of the National Ambient Air Quality Standard (NAAQS). The Federal Equivalent Method (FEM), Beta Attenuation Monitor Model 1020 (BAM 1020) measured a (midnight to midnight) 24-hr average Particulate Matter less than 10 microns (PM_{10}) concentration of 156 µg/m^3, 164 µg/m^3, and 170 µg/m^3, respectively (**Table 1-1**). PM_{10} 24-hr measurements above 150 µg/m^3 are exceedances of the NAAQS. Three of the five SLAMS located in Imperial County at Brawley, Westmorland and El Centro measured an exceedance of the PM_{10} NAAQS on August 19, 2016 or August 21, 2016.

TABLE 1-1
CONCENTRATIONS OF PM_{10} ON AUGUST 19, 2016 AND AUGUST 21, 2016

DATE	MONITORING SITE	AQS ID	POC(s)	HOURS	24-HOUR CONCENTRATION µg/m^3	PM_{10} NAAQS µg/m^3
8/19/2016	**Brawley**	**06-025-0007**	**3**	**24**	**156**	**150**
8/19/2016	**Westmorland**	**06-025-4003**	**3**	**23**	**164**	**150**
8/21/2016	**El Centro**	**06-025-1003**	**4**	**24**	**170**	**150**
8/18/2016	Brawley	06-025-0007	3	24	63	150
8/18/2016	Calexico	06-025-0005	3	24	55	150
8/18/2016	El Centro	06-025-1003	4	24	50	150
8/18/2016	Niland	06-025-4004	3	24	138	150
8/18/2016	Westmorland	06-025-4003	3	24	86	150
8/19/2016	Calexico	06-025-0005	3	24	114	150
8/19/2016	El Centro	06-025-1003	4	24	143	150
8/19/2016	Niland	06-025-4004	3	24	152	150
8/20/2016	Brawley	06-025-0007	3	24	84	150
8/20/2016	Calexico	06-025-0005	3	24	89	150
8/20/2016	El Centro	06-025-1003	3	24	89	150
8/20/2016	Niland	06-025-4004	3	24	93	150
8/20/2016	Westmorland	06-025-4003	3	24	82	150
8/21/2016	Brawley	06-025-0007	3	24	114	150
8/21/2016	Calexico	06-025-0005	3	24	139	150
8/21/2016	Niland	06-025-4004	3	24	77	150
8/21/2016	Westmorland	06-025-4003	3	24	118	150

All time referenced throughout this document is in Pacific Standard Time (PST) unless otherwise noted[1]
August 18, 2016 through August 21, 2016 were not scheduled sampling days

[1] According to the National Institute of Standards and Technology (NIST) Time and Frequency Division the designation of the time of day for specific time zones are qualified by using the term "standard time" or "daylight time". For year-round use the designation can be left off inferring "local time" daylight or standard whichever is present. For 2016, Pacific Daylight Time (PDT) is March 13 through November 6. https://www.nist.gov/pml/time-and-frequency-division/local-time-faqs#intl

The Imperial County Air Pollution Control District (ICAPCD) has been submitting PM_{10} data from Federal Reference Method (FRM) Size Selective Inlet (SSI) instruments since 1986 into the United States Environmental Protection Agency's (USEPA) Air Quality System (AQS). Prior to 2013 all continuous measured PM_{10} data was non-regulatory, thus measured in local conditions. However, by 2013 ICAPCD began formally submitting continuous FEM PM_{10} data from BAM 1020's into the USEPA managed AQS. Because regulatory consideration of reported data must be in standard conditions, as required by USEPA, all continuous PM_{10} data since 2013 is regulatory.

On August 19, 2016, a weak and nearly stationary closed low, off Point Conception, created a low-level flow from the west, which combined, with a mid-level flow from the south-southeast, allowing moisture to remain resulting in scattered thunderstorms along the San Diego and Imperial County line. These thunderstorms, while short-lived produced local rainfall near 1 inch, along with gusty winds and patchy blowing dust affecting air quality and causing an exceedance at the Brawley and Westmorland monitors. On August 20, 2016, a weak instability even with residual moisture kept thunderstorm activity within Arizona and away from the San Diego Mountains. As the closed low continued to remain nearly stationary off Point Conception and the unstable air mass over Yuma County, allowed moisture to remain within the desert southwest. Ideal meteorological conditions, developing August 20, 2018, allowed outflow from thunderstorms over southern Arizona to reach the California desert southwest by August 21, 2016. Outflows brought about a few sprinkles, mainly along the Riverside and San Bernardino Mountains and erratic gusty winds with blowing dust affecting air quality and causing an exceedance at the El Centro monitor on August 21, 2016.

This report demonstrates that a naturally occurring event caused an exceedance observed on August 19, 2016 and August 21, 2016, which elevated particulate matter and affected air quality. The report provides concentration to concentration monitoring site analyses supporting a clear causal relationship between the event and the monitored exceedance and provides an analysis supporting the not reasonably controllable or preventable (nRCP) criteria. Furthermore, the report provides information that the exceedances would not have occurred without the transport of windblown dust from outlying open natural deserts and mountains within the Sonoran Desert. The document further substantiates the request by the ICAPCD to exclude the PM_{10} 24-hour NAAQS exceedance of 156 µg/m^3, 164 µg/m^3 and 170 µg/m^3, respectively (**Table 1-1**) as an exceptional event. This demonstration substantiates that this event meets the definition of the USEPA Regulation for the Treatment of Data Influenced by Exceptional Events (EER).[2]

I.1 Demonstration Contents

Section II - Describes the August 19, 2016 and August 21, 2016 event as it occurred in California and into Imperial County, providing background information of the exceptional event and explaining how the wind driven emissions from the event led to the exceedances at the Brawley

[2] "Treatment of Data Influenced by Exceptional Events; Final Guidance", 81 FR 68216, October 2, 2016

and Westmorland monitors.

Section III – Using time-series graphs, summaries and historical concentration comparisons of the Brawley, Westmorland and El Centro monitors this section discusses and establishes how the August 19, 2016 and August 21, 2016 event affected air quality such that a clear causal relationship is demonstrated between the event and the monitored exceedance. It is perhaps of some value to mention that the time-series graphs include PM_{10} data measured in both local conditions and standard conditions. Measured PM_{10} continuous data prior to 2013 is in local conditions, all other data is in standard conditions. The concentration difference between local and standard conditions has an insignificant impact on any data analysis. Overall, this section provides the evidence that human activity played little or no direct causal role in the August 19, 2016 and August 21, 2016 event and its resulting emissions defining the event as a "natural event".[3]

Section IV - Provides evidence that the event of August 19, 2016 and August 21, 2016 was not reasonably controllable or preventable despite the full enforcement and implementation of Best Available Control Measures (BACM).

Section V - Brings together the evidence presented within this report to show that the exceptional event affected air quality; that the event was not reasonably controllable or preventable; that there was a clear causal relationship between the event and the exceedance, and that the event was a natural event.

I.2 Requirement of the Exceptional Event Rule

The above sections combined comprise the technical requirements described under the Exceptional Events Rule (EER) under 40 CFR §50.14(c)(3)(iv). However, in order for the USEPA to concur with flagged air quality monitoring data, there are additional non-technical requirements.

I.2.a Public Notification that a potential event was occurring (40 CFR §50.14(c)(1))

The ICAPCD published the National Weather Service (NWS) forecast for August 19, 2016 through August 22, 2016. The published notification, via the ICAPCD's webpage, forecast included the description of a weak low-pressure system off the Southern California coast as causing a slight cooling through early next week. Although confidence of regional thunderstorms was not high, the NWS opted to include the potential of thunderstorm activity in California and Arizona. Thus the forecast description included the presence of residual mid-level monsoonal moisture that would allow for a slight chance of afternoon and early evening thunderstorms along the San Bernardino, Riverside Mountains and the San Diego Mountains and deserts. The accompanying San Diego NWS weather story issued for August 19, 2016 identified the location, timing and

[3] Title 40 Code of Federal Regulations part 50: §50.1(k) Natural event means an event and its resulting emissions, which may recur at the same location, in which human activity plays little or no direct causal role. For purposes of the definition of a natural event, anthropogenic sources that are reasonably controlled shall be considered to not play a direct role in causing emissions.

impacts of the potential afternoon and evening thunderstorms. The identified threats from the storms included gusty winds, patchy blowing dust, lightening, small hail and very isolated rainfall. The forecast indicated that the weather system would pass through the middle of the coming week indicating an effect upon the region for days.

Because gusty winds would potentially suspend particles causing poor air quality, the ICAPCD issued a "Marginal Green Waste Only" burn day for Imperial County August 19, 2016 and August 20, 2016. As the system intensified and the potential for suspend particles increased the ICAPCD declared a “No Burn” day on August 21, 2016. **Appendix A** contains copies of pertinent notices to the August 19, 2016 and August 21, 2016 event.

I.2.b Initial Notification of Potential Exceptional Event (INPEE) (40 CFR §50.14(c)(2))

States are required under federal regulation to submit measured ambient air quality data into the AQS. AQS is the federal repository of Quality Assured and Quality Controlled (QA/QC) ambient air data used for regulatory purposes. When States intend to request the exclusion of one or more exceedances of a NAAQS as an exceptional event a notification to the Administrator is required. The notification is accomplished by flagging the data in AQS and providing an initial event description.

On October 3, 2016, the US EPA promulgated revisions to the Exceptional Events rule, which included the requirement of an “Initial Notification of Potential Exceptional Event” (INPEE) process. This revised INPEE process requires communication between the US EPA regional office and the State, prior to the development of a demonstration. The intent of the INPEE process is twofold: to determine whether identified data may affect a regulatory decision and whether a State should develop/submit an EE Demonstration.

The ICAPCD made a formal written request to the California Air Resources Board (CARB) to place preliminary flags on SLAMS measured PM_{10} concentrations from the Brawley, Calexico, El Centro, and Westmorland monitors on April 17, 2017. For the August 19, 2016 and the August 21, 2016 events, the INPEE was formally submitted by the CARB to USEPA Region 9 on April 24, 2017. Subsequently there after a second revised request was sent to CARB requesting preliminary flags on additional days during 2016. **Table 1-1** above provides the PM_{10} measured concentrations for all monitors in Imperial County for August 19, 2016 and August 21, 2016. A brief description of the meteorological conditions was provided to CARB, which provided preliminary information that indicated a potential natural event had occurred on August 19, 2016 and August 21, 2016.

I.2.c Documentation that the public comment process was followed for the event demonstration that was flagged for exclusion (40 CFR §50.14(c)(3)(v))

The ICAPCD posted, for a 30-day public review, a draft version of this demonstration on the ICAPCD webpage and published a notice of availability in the Imperial Valley Press on August 17, 2018. The notice advised the public that comments were being solicited regarding this demonstration, which supports the request, by the ICAPCD, to exclude the measured

concentrations of 156 µg/m^3 (Brawley), 170 µg/m^3 (El Centro), and 164 µg/m^3 (Westmorland) which occurred on August 19, 2016 and August 21, 2016 (**Table 1-1**). The final closing date for comments was September 17, 2018. **Appendix A** contains a copy of the public notice affidavit along with any comments received by the ICAPCD for submittal as part of the demonstration (40 CFR §50.14(c)(3)(v)).

I.2.d Documentation submittal supporting an Exceptional Event Flag (40 CFR §50.14(c)(3)(i))

States that have flagged data as a result of an exceptional event and who have requested an exclusion of said flagged data are required to submit a demonstration that justifies the data exclusion to the USEPA in accordance with the due date established by USEPA during the INPEE process (40 CFR §50.14(c)(2)). Currently, bi-weekly meetings between USEPA, CARB and Imperial County are set to discuss each flagged exceedance for 2016.

The ICAPCD, after the close of the comment period and after consideration of the comments will submit this demonstration along with all required elements, including received comments and responses to USEPA Region 9 in San Francisco, California. The submittal of the August 19, 2016 and August 21, 2016 demonstration will have a regulatory impact upon the development and ultimate submittal of the PM_{10} State Implementation Plan for Imperial County in 2018.

I.2.e Necessary demonstration to justify an exclusion of data under (40 CFR§50.14(c)(3)(iv))

A This demonstration provides evidence that the event, as it occurred on August 19, 2016 and August 21, 2016, satisfies the definition in 40 CFR §50.1(j) and (k) for an exceptional event.

- a The event created the meteorological conditions that entrained emissions and caused the exceedance.
- b The event clearly "affects air quality" such that there is the existence of a clear causal relationship between the event and the exceedance.
- c Analysis demonstrates that the event-influenced concentrations compared to concentrations at the same monitor at other times supports the clear causal relationship.
- d The event "is not reasonably controllable and not reasonably preventable."
- e The event is "caused by human activity that is unlikely to recur at a particular location or [is] a natural event."
- f The event is a "natural event" where human activity played little or no direct causal role.

B This demonstration provides evidence that the exceptional event affected air quality in Imperial County by demonstrating a clear causal relationship between the event and the measured concentrations in Brawley and Westmorland.

C This demonstration provides evidence of the measured concentrations to concentrations at the same monitor at other times supporting the clear causal relationship between the event and the affected monitor.

II August 19, 2016 and August 21, 2016 Conceptual Model

This section provides a summary description of the meteorological and air quality conditions under which the August 19, 2016 and August 21, 2016 event unfolded in Imperial County. The subsection elements include

- » A description and map of the geographic setting of the air quality and meteorological monitors
- » A description of Imperial County's climate
- » An overall description of meteorological and air quality conditions on the event day.

II.1 Geographic Setting and Monitor Locations

According to the United States Census Bureau, Imperial County has a total area of 4,482 square miles of which 4,177 square miles is land and 305 square miles is water. Much of Imperial County is below sea level and is part of the Colorado Desert an extension of the larger Sonoran Desert (**Figure 2-1)**.The Colorado Desert not only in includes Imperial County but a portion of San Diego County.

FIGURE 2-1
COLORADO DESERT AREA IMPERIAL COUNTY

Fig 2-1: 1997 California Environmental Resources Evaluation System. According to the United States Geological Survey (USGS) Western Ecological Research Center the Colorado Desert bioregion is part of the bigger Sonoran Desert Bioregion which includes the Colorado Desert and Upper Sonoran Desert sections of California and Arizona, and a portion of the Chihuahuan Basin and Range Section in Arizona and New Mexico (Forest Service 1994)

A notable feature in Imperial County is the Salton Sea, which is at approximately 235 feet below sea level. The Chocolate Mountains are located east of the Salton Sea and extend in a northwest-southeast direction for approximately 60 miles (**Figure 2-2)**. In this region, the geology is dominated by the transition of the tectonic plate boundary from rift to fault. The southernmost strands of the San Andreas Fault connect the northern-most extensions of the East Pacific rise. Consequently, the region is subject to earthquakes and the crust is being stretched, resulting in a sinking of the terrain over time.

FIGURE 2-2
SURROUNDING AREAS OF THE SALTON SEA

Fig 2-2: Image courtesy of the Image Science and Analysis Laboratory NASA Johnson Space Center, Houston Texas

All of the seven incorporated cities, including the unincorporated township of Niland, are surrounded by agricultural fields to the north, east, west and south (**Figure 2-6)**. Together, the incorporated cities, including Niland, and the agricultural fields make what is known as the Imperial Valley. Surrounding the Imperial Valley are desert areas found on the eastern and western portions of Imperial County.

The desert area, found within the western portion of Imperial County is of note because of its border with San Diego County. From west to east, San Diego County stretches from the Pacific Ocean to its boundary with Imperial County. San Diego County has a varied topography. On its western side is 70 miles (110 km) of coastline. Most of San Diego between the coast and the Laguna Mountains consists of hills, mesas, and small canyons. Snow-capped (in winter)

mountains rise to the northeast, with the Sonoran Desert to the far east. Cleveland National Forest is spread across the central portion of the county, while the Anza-Borrego Desert State Park occupies most of the northeast. The southeastern portion of San Diego County is comprised of distinctive Peninsular mountain ranges. The mountains and deserts of San Diego comprise the eastern two-thirds of San Diego County and are primarily undeveloped back county with a native plant community known as chaparral. Of the nine major mountain ranges within San Diego County, the In-Ko-Pah Mountains and the Jacumba Mountains border Mexico and Imperial County.

Both mountain ranges provide the distinctive weathered dramatic piles of residual boulders that can be seen while driving Interstate 8 from Imperial County through Devil's Canyon and In-Ko-Pah Gorge. Interstate 8 runs along the US border with Mexico from San Diego's Mission Bay to just southeast of Casa Grande Arizona.

FIGURE 2-3
JACUMBA PEAK

Fig 2-3: The Jacumba Mountains reach an elevation of 4,512 feet (1,375 m) at Jacumba Peak, near the southern end of the chain. Source: Wikipedia at https://en.wikipedia.org/wiki/Jacumba_Mountains

Northwest and northeast of the Jacumba Mountains is the Tierra Blanca Mountains, the Sawtooth Mountains and Anza-Borrego Desert State Park. Within the mountain ranges and the Anza-Borrego Desert State Park, there exists the Vallecito Mountains, the Carrizo Badlands, the Carrizo Impact Area, Coyote Mountains and the Volcanic Hills to name of few. Characteristically, these areas all have erosion that has occurred over time that extends from the Santa Rosa Mountains into northern Baja California in Mexico. For example, the Coyote Mountains consists of sand dunes left over from the ancient inland Sea of Cortez. Much of the terrain is still loose dirt, interspersed with sandstone and occasional quartz veins. The nearest community to the Coyote Mountain range is the community of Ocotillo. Of interest are the fossilized and hollowed out sand dunes that produce wind caves.

FIGURE 2-4
ANZA-BORREGO DESERT STATE PARK
CARRIZO BADLANDS

Fig 2-4: View southwest across the Carrizo Badlands from the Wind Caves in Anza-Borrego Desert State Park. Source: Wikipedia at https://en.wikipedia.org/wiki/Carrizo_Badlands

The Carrizo Badlands, which includes the Carrizo Impact Area used by the US Navy as an air-to-ground bombing range during World War II and the Korean War, lies within the Anza-Borrego Desert State Park. The Anza-Borrego Desert State Park is located within the Colorado Desert, is the largest state park in California occupying eastern San Diego County, reaching into Imperial and Riverside counties. The two communities within Anza-Borrego Desert State Park are Borrego Springs and Shelter Valley.

The Anza-Borrego Desert State Park lies in a unique geologic setting along the western margin of the Salton Trough. The area extends north from the Gulf of California to San Gorgonio Pass and from the eastern rim of the Peninsular Ranges eastward to the San Andreas Fault zone along the far side of the Coachella Valley. The Anza-Borrego region changed gradually over time from intermittently being fed by the Colorado River Delta to dry lakes and erosion from the surrounding mountain ranges. The area located within the southeastern and northeastern section of San Diego County is a source of entrained fugitive dust emissions that impact Imperial County when westerly winds funnel through the unique landforms causing in some cases wind tunnels that cause increases in wind speeds.

Historical observations have indicated that the desert slopes and mountains of San Diego are a source of fugitive emissions along with those deserts located to the east and west of Imperial County, which extend into Mexico (Sonoran Desert, **Figure 2-7**). Combined, the desert areas and mountains of San Diego and the desert areas that extend into Mexico are sources of dust emissions, which affect the Imperial County during high wind events.

FIGURE 2-5
ANZA-BORREGO DESERT STATE PARK
DESERT VIEW FROM FONT'S POINT

Fig 2-5: Desert view from Font's Point. Source: Font's Point Anza-Borrego Photographed by and copyright of (c) David Corby; Wikipedia at https://en.wikipedia.org/wiki/Anza-Borrego_Desert_State_Park

FIGURE 2-6
LOCATION AND TOPOGRAPHY OF IMPERIAL COUNTY

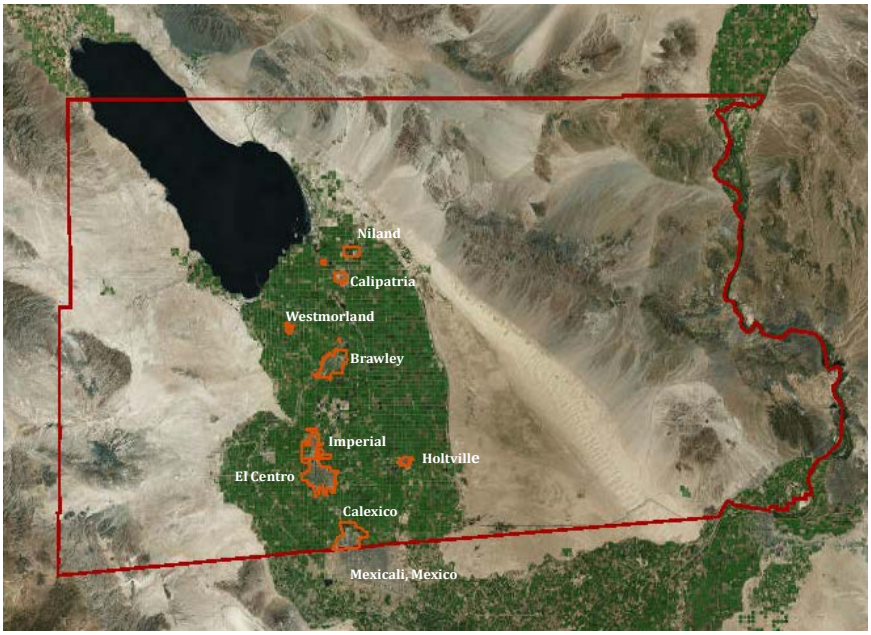


Fig 2-6: Depicts the seven incorporated cities within Imperial Valley - City of Calipatria, City of Westmorland, City of Brawley, City of Imperial, City of El Centro, City of Holtville, City of Calexico. Niland is unincorporated. Mexicali, Mexico is to the south.

FIGURE 2-7
DESERTS IN CALIFORNIA, YUMA AND MEXICO

Fig 2-7: Depicts the Sonoran Desert as it extends from Mexico into Imperial County. Source: Google Earth Terra Matrics

The air quality and meteorological monitoring stations used in this demonstration are shown in **Figure 2-8**. Of the five SLAMS within Imperial County four stations measure both meteorological and air quality data. These SLAMS are located in Calexico, El Centro, Westmorland, and Niland; the station located in Brawley only measures air quality. Other air monitoring stations measuring air quality and meteorological data used for this demonstration include stations in eastern Riverside County, southeastern San Diego County and southwestern Arizona (Yuma County) (**Figure 2-8 and Table 2-1)**.

As mentioned above, the PM_{10} exceedance on August 19, 2016 and August 21, 2016, occurred at the Brawley, Westmorland and El Centro stations. The Brawley, Niland, and Westmorland stations are regarded as the "northern" monitoring sites within the Imperial County air monitoring network. In order to properly analyze the contributions from meteorological conditions occurring on August 19, 2016, other meteorological sites were used in this demonstration which include airports in eastern Riverside County, southeastern San Diego County, southwestern Arizona (Yuma County), Imperial County, and other sites relevant to the wind event, such as within northern Mexico. (**Figure 2-8 and Appendix B)**.

FIGURE 2-8
MONITORING SITES IN AND AROUND IMPERIAL COUNTY

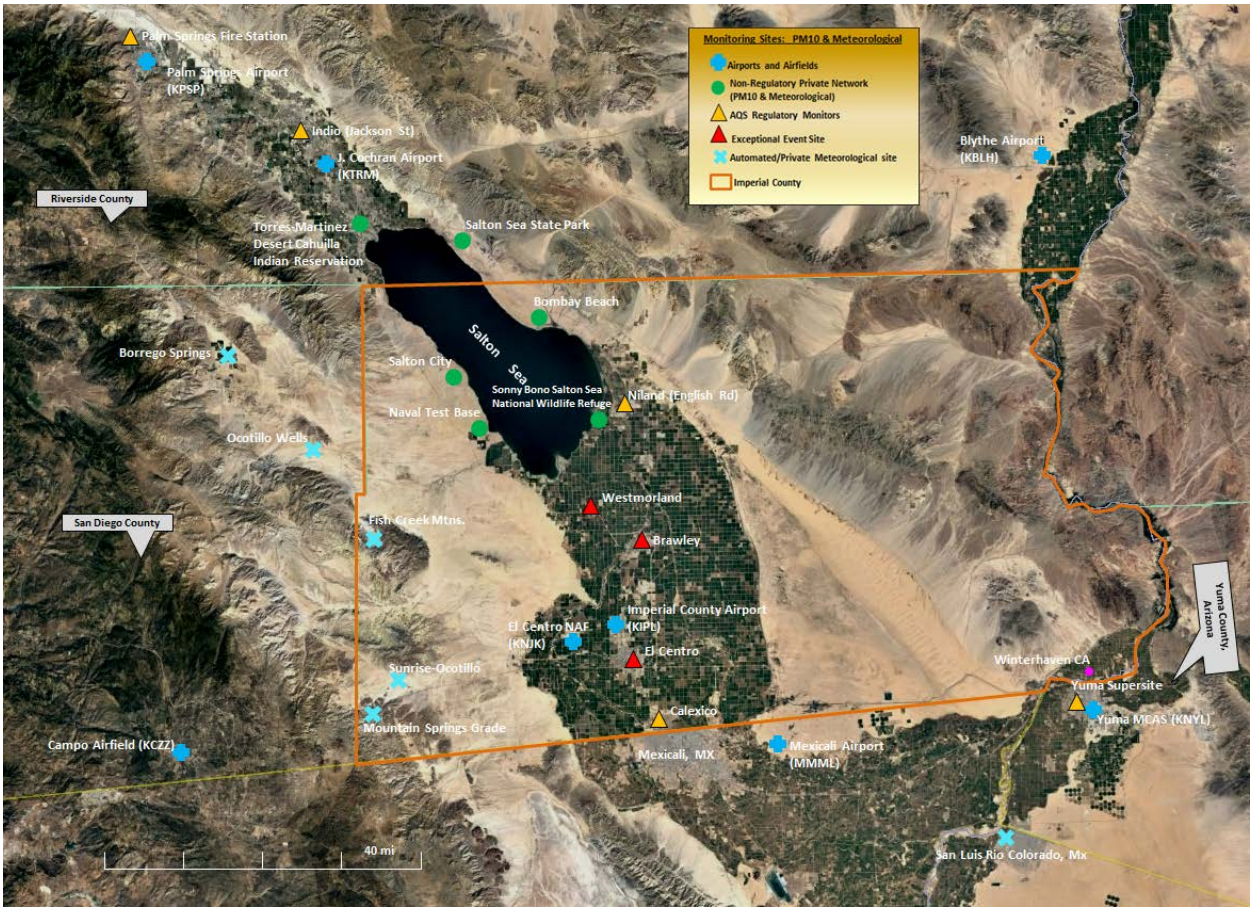


Fig 2-8: Depicts a select group of meteorological and PM_{10} monitoring sites in Imperial County, eastern Riverside County, southeastern San Diego County, southwestern Arizona (Yuma County), and northern Mexico. The image provides the location of potential sites used to gather data in support an Exceptional Event Demonstration. Source: Google Earth

In addition to meteorological sites, there are non-regulatory PM_{10} sites located around the Salton Sea that maybe referenced as an aid to help the reader understand the direction and velocity of winds that affect Imperial County. Unless, otherwise specifically indicated concentration references do not imply emissions from the surrounding playa of the Salton Sea. Three sites, in specific, are the Salton City air monitoring station, the Naval Test Base air monitoring station and the Sonny Bono air monitoring station. These privately owned and non-regulatory stations are located closest to the Imperial County air monitoring network (**Figures 2-9 to 2-12**). The Salton City station is located 33.27275°N latitude and 115.90062˚W longitude, on the western edge of the Salton Sea (**Figure 2-9**). The station abuts a water reservoir along the Salton Sea with surrounding chaparral vegetation and unpaved open areas and roads. The Naval Test Base station is located 33.16923°N latitude and 115.85593˚W longitude, on the southwestern edge of the Salton Sea (**Figure 2-11**). The station sits on an abandoned US Military site, still owned by the Department of Defense. Unlike the Salton City station, light chaparral vegetation and sandy open

dune areas surround the Naval Test Base station. Directly to the west of the station is an orchard. The Sonny Bono station is located 33.17638°N latitude and 115.62310˚W longitude, on the southern portion of the Salton Sea within the Sonny Bono Salton Sea Wildlife Refuge. The Sonny Bono Salton Sea National Wildlife Refuge is 40 miles north of the Mexican border at the southern end of the Salton Sea within the Sonoran Desert. The Refuge has two separate managed units, 18 miles apart. Each unit contains wetland habitats, farm fields, and tree rows. The land of the Salton Sea Refuge is flat, except for Rock Hill, a small, inactive volcano, located near Refuge Headquarters. Bordering the Refuge is the Salton Sea on the north and farmlands on the east, south, and west.

FIGURE 2-9
SALTON CITY AIR MONITORING STATION

Fig 2-9: Depicts the Salton City air monitoring (circled) site operated by a private entity. View site photos at the California Air Resources Board monitoring website at https://www.arb.ca.gov/qaweb/sitephotos.php?site_no=13604&date=17

FIGURE 2-10
SALTON CITY AIR MONITORING STATION
WEST

Fig 2-10: Photograph taken by the California Air Resources Board audit team in 2017. The photograph taken from the west facing the probe. https://www.arb.ca.gov/qaweb/sitephotos.php?site_no=13604&date=17

FIGURE 2-11
NAVAL TEST BASE AIR MONITORING STATION

Fig 2-11: Depicts the Naval Test Base air monitoring (circled) site operated by a private entity. To view the site photos visit the California Air Resources Board monitoring website at https://www.arb.ca.gov/qaweb/sitephotos.php?site_no=13603&date=17

FIGURE 2-12
NAVAL TEST BASE AIR MONITORING STATION
WEST

Fig 2-12: Photograph taken by the California Air Resources Board audit team in 2017. The photograph taken from the west facing the probe. https://www.arb.ca.gov/qaweb/sitephotos.php?site_no=13604&date=17

FIGURE 2-13
SONNY BONO AIR MONITORING STATION

Fig 2-13: Depicts the Sonny Bono air monitoring (circled) site operated by a private entity. To view the site photos visit the California Air Resources Board monitoring website at https://www.arb.ca.gov/qaweb/sitephotos.php?site_no=13604&date=17

FIGURE 2-14
SONNY BONO SALTON SEA NATIONAL WILDLIFE REFUGE

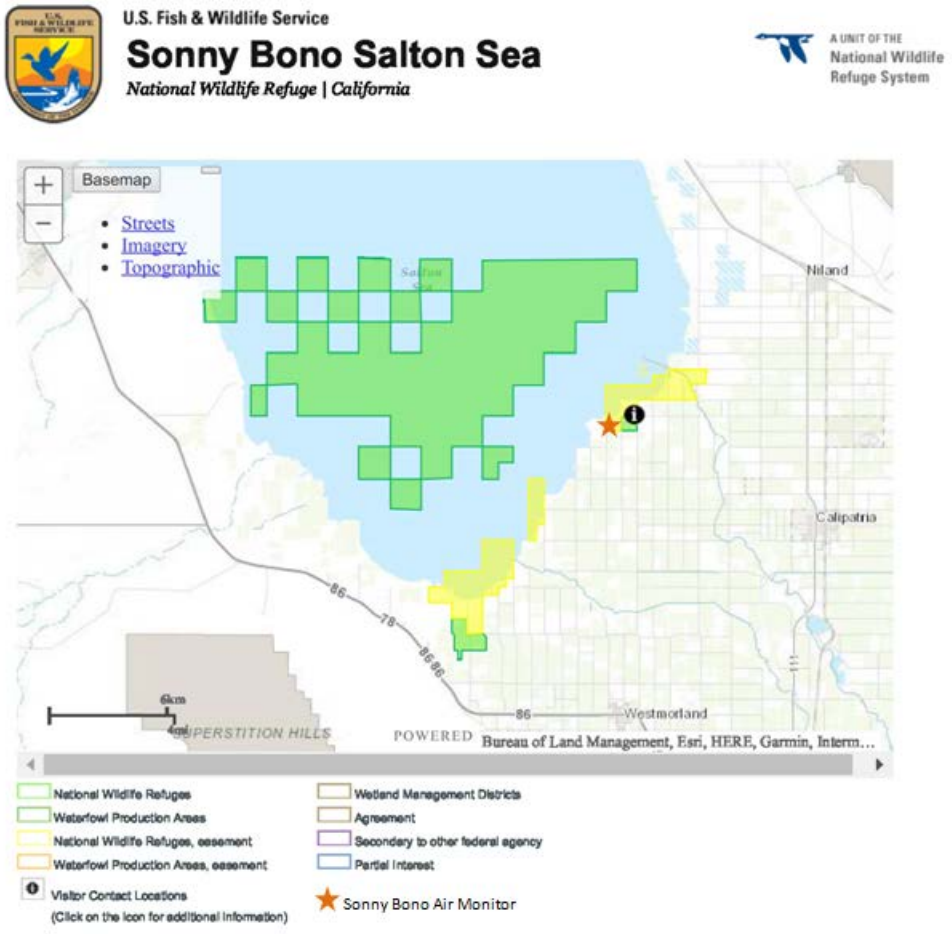


Fig 2-14: The Sonny Bono Wildlife Refuge has about 2,000 acres that are farmed and managed for wetlands. In 1998, the Refuge was renamed after Congressman Sonny Bono, who helped inform the U.S. Congress of the environmental issues facing the Salton Sea as well as acquiring funding for this Refuge to help it respond to avian disease outbreaks and other habitat challenges at the Salton Sea. Source: https://www.fws.gov/refuge/Sonny_Bono_Salton_Sea/about.html

TABLE 2-1
MONITORING SITES IN IMPERIAL COUNTY, RIVERSIDE COUNTY AND ARIZONA
AUGUST 19, 2016 AND AUGUST 21, 2016

Monitor Site Name	*Operator	Monitor Type	AQS ID	AQS PARAMETER CODE	ARB Site Number	Elevation (meters)	Day	24-hr PM_{10} ($\mu g/m^3$) Avg	1-hr PM_{10} ($\mu g/m^3$) Max	**Time of Max Reading	Max Wind Speed (mph)	**Time of Max Wind Speed
IMPERIAL COUNTY												
Brawley-Main Street #2	ICAPCD	BAM 1020	06-025-0007	(81102)	13701	-15	19	156	995	17:00	-	-
							21	**114**	**381**	**03:00**	**-**	**-**
Calexico-Ethel Street	CARB	BAM 1020	06-025-0005	(81102)	13698	3	19	115	985	17:00	10.4	17:00
							21	**139**	**552**	**00:00**	**10.1**	**00:00**
El Centro-9th Street	ICAPCD	BAM 1020	06-025-1003	(81102)	13694	9	19	143	995	17:00	11.4	17:00
							21	**170**	**750**	**00:00**	**19.3**	**07:00**
Niland-English Road	ICAPCD	BAM 1020	06-025-4004	(81102)	13997	-57	19	152	798	18:00	21	00:00
							21	**76**	**141**	**00:00**	**12.1**	**00:00**
Westmorland	ICAPCD	BAM 1020	06-025-4003	(81102)	13697	-43	19	164	995	17:00	8.5	18:00
							21	**118**	**364**	**03:00**	**10**	**00:00**
RIVERSIDE COUNTY												
Palm Springs Fire Station	SCAQMD	TEOM	06-065-5001	(81102)	33137	174	19	34	80	08:00	10	16:00
							21	**75**	**252**	**23:00**	**4**	**00:00**
Indio (Jackson St.)	SCAQMD	TEOM	06-065-2002	(81102)	33157	1	19	54	178	01:00	10.8	21:00
							21	**84**	**159**	**02:00**	**8.1**	**01:00**
ARIZONA – YUMA												
Yuma Supersite	ADEQ	TEOM	04-027-8011	(81102)	N/A	60	19	-	-	-	-	-
							21	**-**	**-**	**-**	**-**	**-**

*CARB = California Air Resources Board
*ICAPCD = Air Pollution Control District, Imperial County
*SCAQMD = South Coast Air Management Quality District
*ADEQ =Arizona Department of Environmental Quality

**Time represents the actual time/hour of the measurement in question according to the zone time (PST unless otherwise noted)
August 18, 2016 through August 21, 2016 wer not scheduled sampling days

II.2 Climate

As mentioned above, Imperial County is part of the Colorado Desert, which is a subdivision of the larger Sonoran Desert (**Figure 2-15**) encompassing approximately 7 million acres (28,000 km^2). The desert area encompasses Imperial County and includes parts of San Diego County, Riverside County, and a small part of San Bernardino County.

FIGURE 2-15
SONORAN DESERT REGION

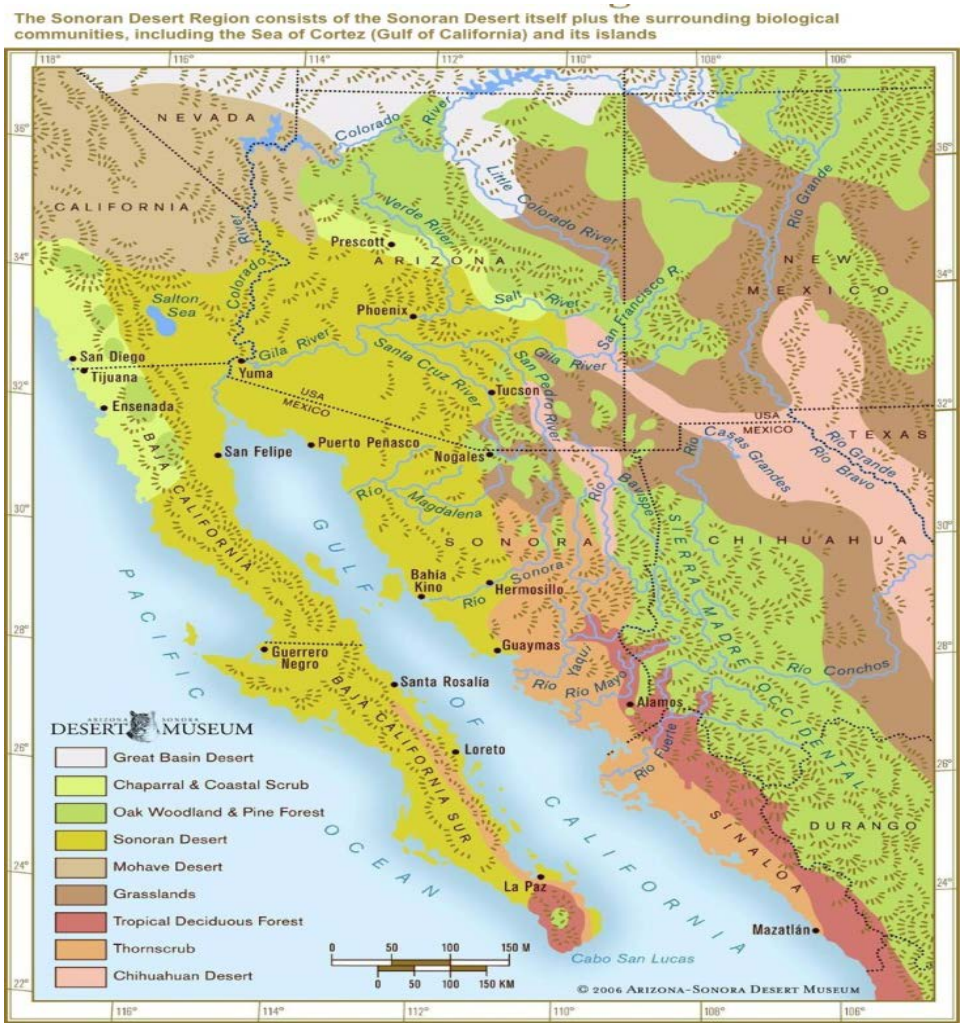


Fig 2-15: Depicts the magnitude of the region known as the Sonoran Desert. Source: Arizona-Sonora Desert Museum at http://desertmuseum.org/center/map.php

The majority of the Colorado Desert lies at a relatively low elevation, below 1,000 feet (300 m), with the lowest point of the desert floor at 275 feet (84 m) below sea level at the Salton Sea. Although the highest peaks of the Peninsular Range reach elevations of nearly 10,000 feet (3,000 m), most of the region's mountains do not exceed 3,000 feet (910 m).

In the Colorado Desert (Imperial County), the geology is dominated by the transition of the tectonic plate boundary from rift to fault. The southernmost strands of the San Andreas Fault connect to the northern-most extensions of the East Pacific Rise. Consequently, the region is subject to earthquakes, and the crust is being stretched, resulting in a sinking of the terrain over time.

The Colorado Desert's climate distinguishes it from other deserts. The region experiences greater summer daytime temperatures than higher-elevation deserts and almost never experiences frost. In addition, the Colorado Desert experiences two rainy seasons per year (in the winter and late summer), especially toward the southern portion of the region which includes a portion of San Diego County. The Colorado Desert portion of San Diego County receives the least amount of precipitation. Borrego Springs, the largest population center within the San Diego desert region averages 5 inches of rain with a high evaporation rate. By contrast, the more northerly Mojave Desert usually has only winter rains.

The west coast Peninsular Ranges, or other west ranges, of Southern California–northern Baja California, block most eastern Pacific coastal air and rains, producing an arid climate. Other short or longer-term weather events can move in from the Gulf of California to the south, and are often active in the summer monsoons. These include remnants of Pacific hurricanes, storms from the southern tropical jet stream, and the northern Inter Tropical Convergence Zone (ITCZ).

The arid nature of the region demonstrated when historic annual average precipitation levels in Imperial County average 2.64" (**Figure 2-16)**. During the 12 month period prior to the August 19, 2016 and August 21, 2016 event, Imperial County measured a total annual precipitation of 0.83 inches. Such arid conditions, as those preceding the event, result in soils that are particularly susceptible to particulate suspension by the elevated gusty winds.

FIGURE 2-16
IMPERIAL COUNTY HISTORICAL WEATHER

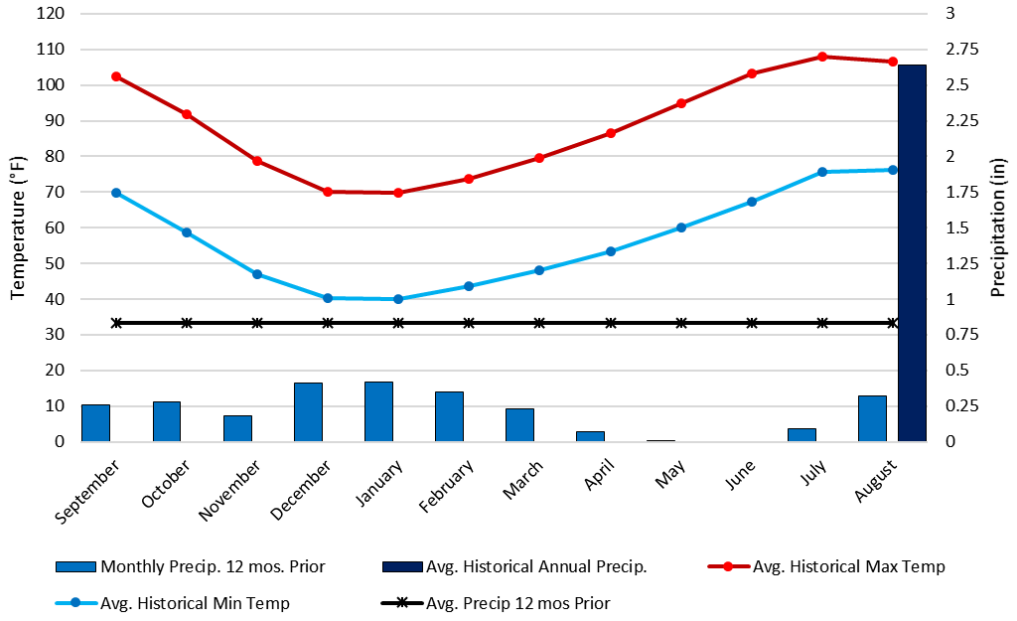


Fig 2-16: In the months prior to August 19, 2016 and August 21, 2016, the region experienced a low total precipitation of 0.83 inches. Average annual precipitation is 2.64 inches. Meteorological data courtesy of Western Regional Climate Center (WRCC) and Weather Underground http://www.wrcc.dri.edu/cgi-bin/climain.pl?ca2713

The NWS explains that the speed of any wind resulting from a weather system is directly proportional to the change in air pressure, called a pressure gradient, such that when the pressure gradient increases so does the speed of the wind.[4] Because the pressure gradient is just the difference in pressure between high and low pressure areas, changes in weather patterns may recur seasonally.

Typically, high pressure brings clear skies and with no clouds there is more incoming shortwave solar radiation causing temperatures to rise. When surface winds become light, the cooling of the air produced directly under a high-pressure system can lead to a buildup of particulates in urban areas under an elongated region of relatively high atmospheric pressure or ridge causing widespread haze. Conversely, a trough is an elongated region of relatively low atmospheric pressure often associated with fronts. Troughs may be at the surface, or aloft under various conditions. Most troughs bring clouds, showers, and a wind shift, particularly following the passage of the trough.

While windblown dust events in Imperial County during the fall, winter, and spring are often due to strong winds associated with low-pressure systems and cold fronts, windblown dust events during the summer monsoon season are often due to wind flow aloft from the East or South-East. This phenomenon is known as the North American Monsoon (NAM)[5]. The NAM occurs when there is a shift in wind patterns during the summer, which occurs as Mexico and the southwest United States warm under intense solar heating reversing airflow from dry land areas to moist ocean areas. Consequently, the prevailing winds start to flow from moist ocean areas into dry land areas (**Figure 2-17**).

[4] NWS JetStream – Origin of Wind http://www.srh.noaa.gov/jetstream/synoptic/wind.html

[5] National Weather Service document "North American Monsoon" public domain material from the NWS Forecast Office Tucson, Arizona

FIGURE 2-17
WEATHER PATTERN OF THE NORTH AMERICAN MONSOON

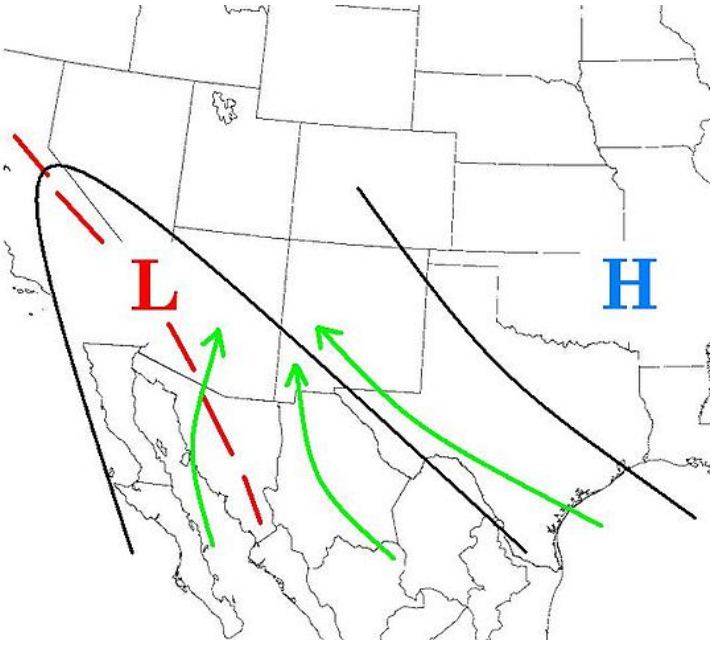


Fig 2-17: Weather pattern of the North American Monsoon. The North American monsoon, variously known as the Southwest monsoon, the Mexican monsoon, or the Arizona monsoon is a pronounced increase in rainfall from an extremely dry June to a rainy July over large areas of the southwestern United States and northwestern Mexico. Image courtesy of Wikipedia "North American Monsoon."

The NAM circulation typically develops in late May or early June over southwest Mexico. By mid to late summer, thunderstorms increase over the "core" region of the southwest United States and northwest Mexico[6]. The transport of moisture into Mexico, Arizona and the southwestern United States can come quickly and sometimes dramatically , known as "bursts" and "breaks" which can unleash violent flash floods, thousands of lightning strikes, crop-damaging hail, and walls of damaging winds and blowing dust.[7]

The monsoon typically arrives in mid to late June over northwest Mexico and early July over the southwest United States. While the southern areas of Mexico experience a low level monsoon circulation, transported primarily from the Gulf of California and the eastern Pacific, an upper level monsoon (or subtropical) ridge develops over the southern High Plains and northern Mexico. Thus, by late June or early July the ridge shifts into the southern Plains or southern Rockies creating less resistance for the mid and upper level moisture streams to enter the United States. If the ridge is too close to a particular area, the sinking air, at its center suppresses

[6] According to the NWS Tucson Arizona regional office report affected areas include the United States, Arizona, New Mexico, Sonora, Chihuahua, Sinaloa and Durango.
[7] 2004: The North American Monsoon. Reports to the Nation on our Changing Planet. NOAA/National Weather Service. Available on line at: http://www.cpc.noaa.gov/products/outreach/Report-to-the-Nation-Monsoon_aug04.pdf

thunderstorms and can result in a significant monsoon "break". However, if the ridge sets up in a few key locations, widespread and potentially severe thunderstorms can develop.

In Imperial County, isolated thunderstorms begin to develop, mainly during the hottest part of the day. The convective uplift of moist air over the hot desert landscape can produce thunderstorms, which in turn can generate gusty and highly variable winds. On occasion, a few of these thunderstorms are pushed by the winds into the lower deserts during the evening hours.

Thus, when high humid air is pushed up the Gulf of California, also known as a gulf surge the most common synoptic pattern is an easterly wave over central Mexico and an intensifying thermal low over the desert southwest. Although current studies include the relationship of gulf surges to tropical easterly and midlatitude westerly waves, additional study remains in order to understand why some gulf surges contain sufficient precipitation while others do not. Suffice to say that during the NAM season there are northward surges of relatively cool, moist maritime air from the eastern tropical Pacific into the southwestern United States via the Gulf of California (e.g. Hales 1972; Brenner 1974; Stensrud et al. 1997; Fuller and Stensrud 2000). These events are related to the amount of convective activity in northwestern Mexico and portions of the southwestern United States.[8]

FIGURE 2-18
CONCEPTUAL DIAGRAM OF GULF SURGE TRIGGER

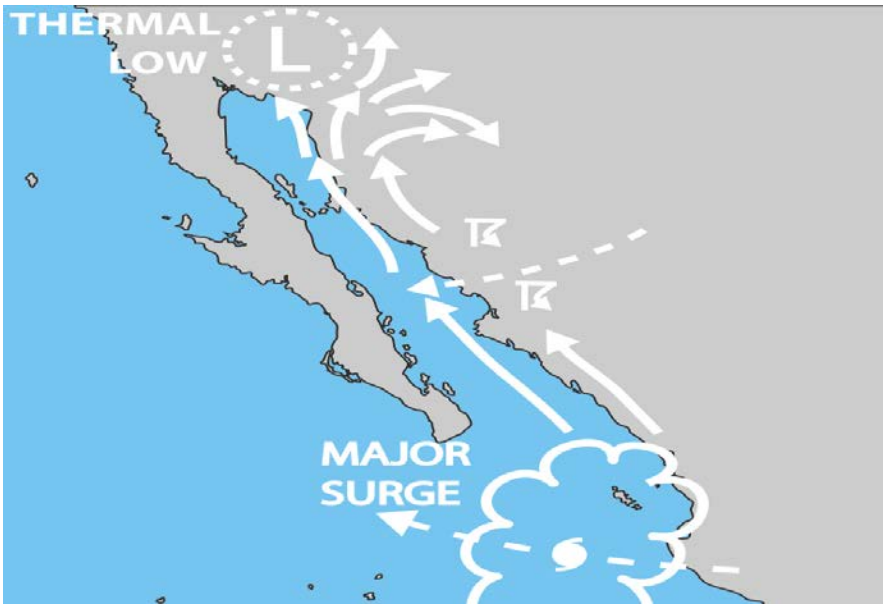


Fig 2-18: A conceptual diagram of how a tropical system can trigger a gulf surge. Source: Gulf of California moisture surge Wikipedia The Free Encyclopedia https://en.wikipedia.org/wiki/Gulf_of_California_moisture_surge

[8] Relationships Between Gulf of California Moisture Surges and Precipitation in the Southwestern United States, R.W. Higgins, W. Shi and C. Hain, Climate Prediction Center, NOAA/NWS/NCEP February 2004 (Journal of Climate – in Press) https://www.eol.ucar.edu/projects/name/documentation/hsh04.pdf

II.3 Event Day Summary

The exceptional event for August 19, 2016 and August 21, 2016, caused by moderate mid-level moisture from Arizona (east) that combined with mostly higher surface humidity (west), began as an intriguing weather pattern where the formation of a Pacific ridge over SoCal and a trough near the central California coast would have effects through August 21, 2016. This is important, because as the weak trough forms, begins as early as Tuesday, August 16, 2016, a series of shortwaves reinforced by the jet stream create dry gusty winds within the San Diego Mountains and deserts providing the meteorological conditions, such as gradual cooling temperatures, that are conducive for the intrusion of moisture from the south.

Essentially, as the weak area of upper level low-pressure moves south towards the coastal waters of southern California a small amount of moisture from the marine layer mixes with the drier exiting layer allowing for a slight increase in humidity within the mountains.[9] By Thursday afternoon, August 18, 2016 the formation of the closed upper low over the central California coast allowed for southerly flow in the mid-levels to bring some monsoonal moisture into the mountains and desert slopes of San Diego, Riverside and to a lesser degree into San Bernardino County. By the evening hours of August 18, 2016 convective cells that formed over the Santa Rosa Mountains (**Figure 2-2**) and within the mountains of northern Baja California triggered short-lived, isolated thunderstorms creating breezy southwesterly winds through Friday, August 19, 2016.[10] While the NWS in Phoenix, interpreted its model information primarily for northern Arizona, residual mid-level monsoonal moisture continued to move in from the east and combined with mostly higher surface humidity causing instability allowing for isolated afternoon and early evening thunderstorms mostly forming over the San Diego mountains and into the deserts on August 19, 2016. Finally, this weak upper low continued to move slowly northeast through Sunday, August 21, 2016 with the moisture profiles not changing substantially allowing additional short-lived thunderstorm activity to occur through Sunday, August 21, 2016.

On August 19, 2016, a weak and nearly stationary closed low, off Point Conception, created a low-level flow from the west, which combined, with a mid-level flow from the south-southeast, allowing moisture to remain resulting in scattered thunderstorms along the San Diego and Imperial County line.[11] These thunderstorms, while short-lived produced local rainfall near 1 inch, along with gusty winds and patchy blowing dust affecting air quality and causing an exceedance at the Brawley and Westmorland monitors on August 19, 2016.

On August 20, 2016, despite the presence of residual moisture within the San Diego Mountains and deserts a weak instability kept thunderstorm activity within central and southeastern Arizona and away from the San Diego Mountains. Essentially, a weak steering flow aloft which favored a westerly direction kept storms along the higher terrain in eastern Arizona during the day.[12]

[9] Area Forecast Discussion, National Weather Service San Diego CA, 830 AM PST (930 AM PDT) and 704 PM PST (804 PM PDT), August 18, 2016.
[10] Area Forecast Discussion, National Weather Service San Diego CA 100 PM PST (200 PM PDT) August 18, 2016.
[11] Area Forecast Discussion, National Weather Service San Diego CA, 828 PM PST (928 PM PDT) Friday, August 19, 2016.
[12] Area Forecast Discussion, National Weather Service Phoenix AZ, 100 PM PST (200 PM MST) Saturday, August 20, 2016

However, as storms developed quickly over the Mongollon rim and the mountains within southeastern Arizona during the afternoon hours, outflow boundaries from these storms moved west and merged with new storms pushing west into the western/southwestern deserts overnight affecting Imperial County on August 21, 2016. Early morning elevated concentrations measured at the air monitors reflect the residual suspended particulates from the previous evening's thunderstorm activities. The brief calm, despite the presence of residual moisture allowed for the settling of particulates before renewed thunderstorm activity during the late evening hours of August 20, 2016.

On August 21, 2016, the continued closed low remaining nearly stationary off Point Conception and the unstable air mass over Yuma County, allowed moisture to remain within the desert southwest providing the ideal meteorological conditions that allowed outflow from thunderstorms over southern Arizona to reach the California desert southwest after 1:00am.[13] These outflows brought about a few sprinkles, mainly along the Riverside and San Bernardino Mountains and erratic gusty winds with blowing dust affecting air quality and causing an exceedance at the El Centro monitor on August 21, 2016.[14]

Figures 2-19 and 2-23 show the upper low over the region, the shortwave trough, the weather system, and the resulting southerly winds from thunderstorm outflows produced by the strong storm cells seen in the final image.

[13] Area Forecast Discussion, National Weather Service San Diego CA, 227 AM PST (327 AM PDT) and Phoenix AZ, 745 PM PST (845 PM MST) Sunday, August 21, 2016.

[14] Area Forecast Discussion, National Weather Service Phoenix AZ, 1256 PM PST (156 PM MST) and San Diego CA, 754 AM PST (854 AM PDT), 1211 PM PST (111 PM PDT), Sunday, August 21, 2016.

FIGURE 2-19
UPPER LEVEL TROUGH AUGUST 19, 2016

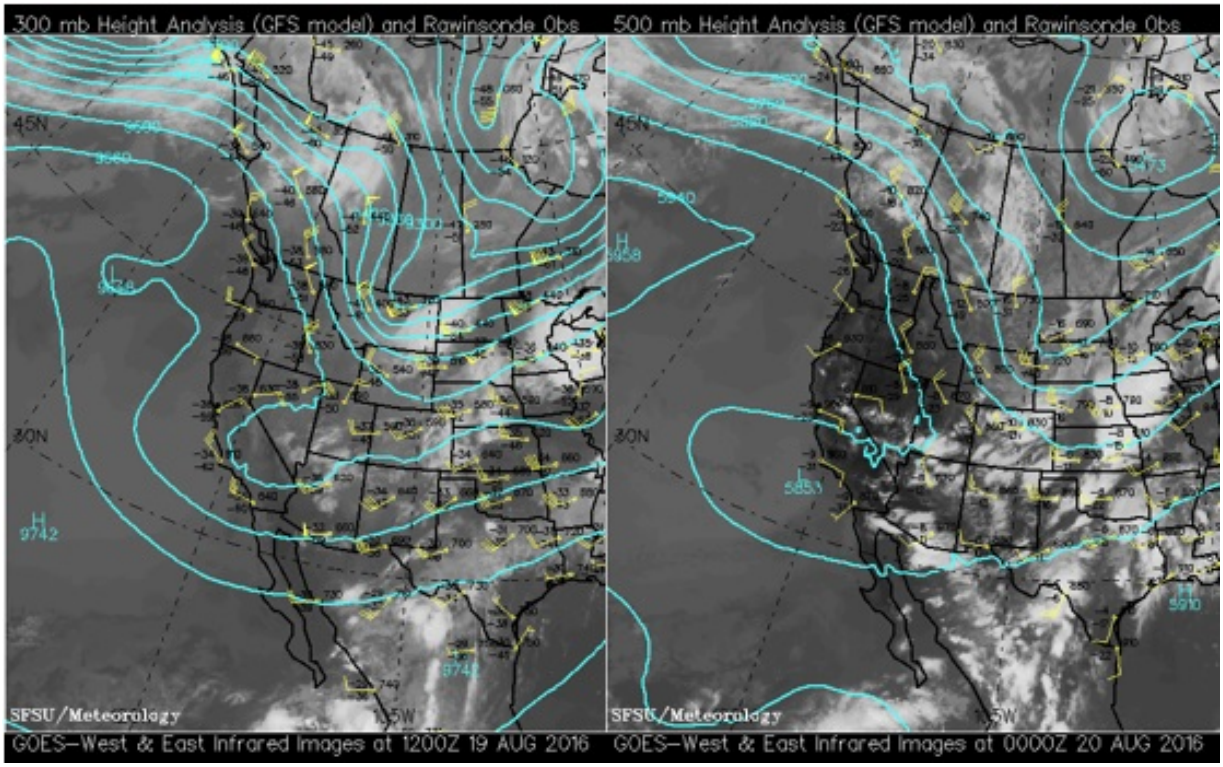


Fig 2-19: A large upper low atypical of August brought cool air in the upper atmosphere over the region. Left: 300mb level at 0400 PST. Right: 500mb at 1600 PST, both August 19, 2016. Source: SFSU Department of Earth and Climate Sciences and the California Regional Weather Server;
http://squall.sfsu.edu/crws/archive/wcsathts_arch.html

FIGURE 2-20
SHORTWAVE TROUGH SLIDES SOUTHWARD AUGUST 19, 2016

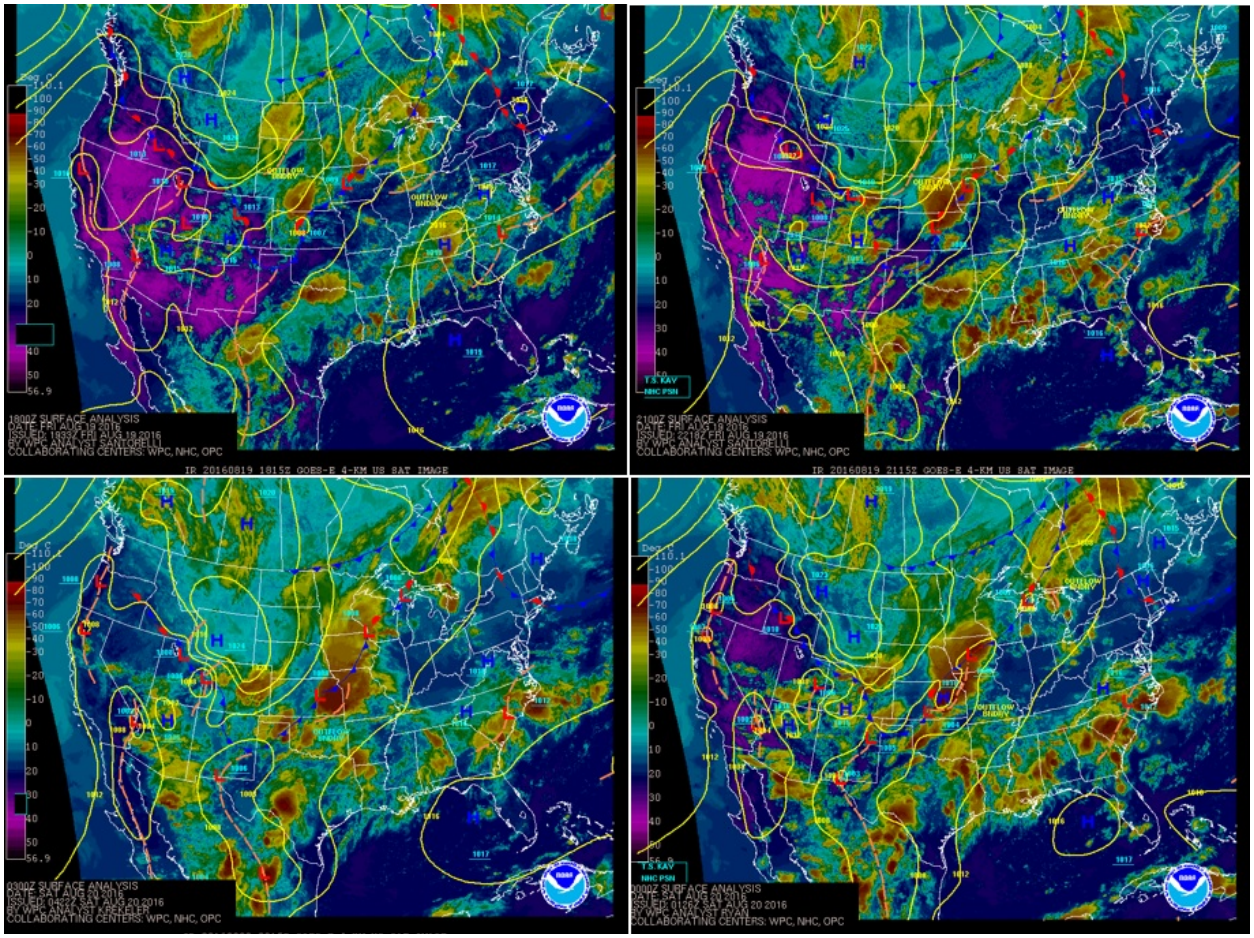


Fig 2-20: As the upper level low moved from the far northern California coast south over the region a shortwave trough near the surface slid southward from southern Nevada during the evening of August 18, 2016 and morning hours of August 19, 2016. Additional storms during the evening hours of August 19, 2016 were enhanced when another shortwave further west combined with greater low-level moisture in the desert southwest and the Jetstream maxima moved further south of the border into Mexico.[15] The contrast between warmer air at the surface and cooler air above promoted convection, which in turn generated thunderstorms and gusty outflow winds. Clockwise, from top left: 1015; 1315, 1615, 1915 PST August 19, 2016. Source: Weather Prediction Center Surface Analysis Archive; http://www.wpc.ncep.noaa.gov/archives/web_pages/sfc/sfc_archive.php

[15] Area Forecast Discussion, National Weather Service, Phoenix AZ 750 PM PST (850 PM MST), Friday, August 19, 2016.

FIGURE 2-21
CLOUDS ASSOCIATED WITH THUNDERSTORM ACTIVITY AUGUST 19, 2016

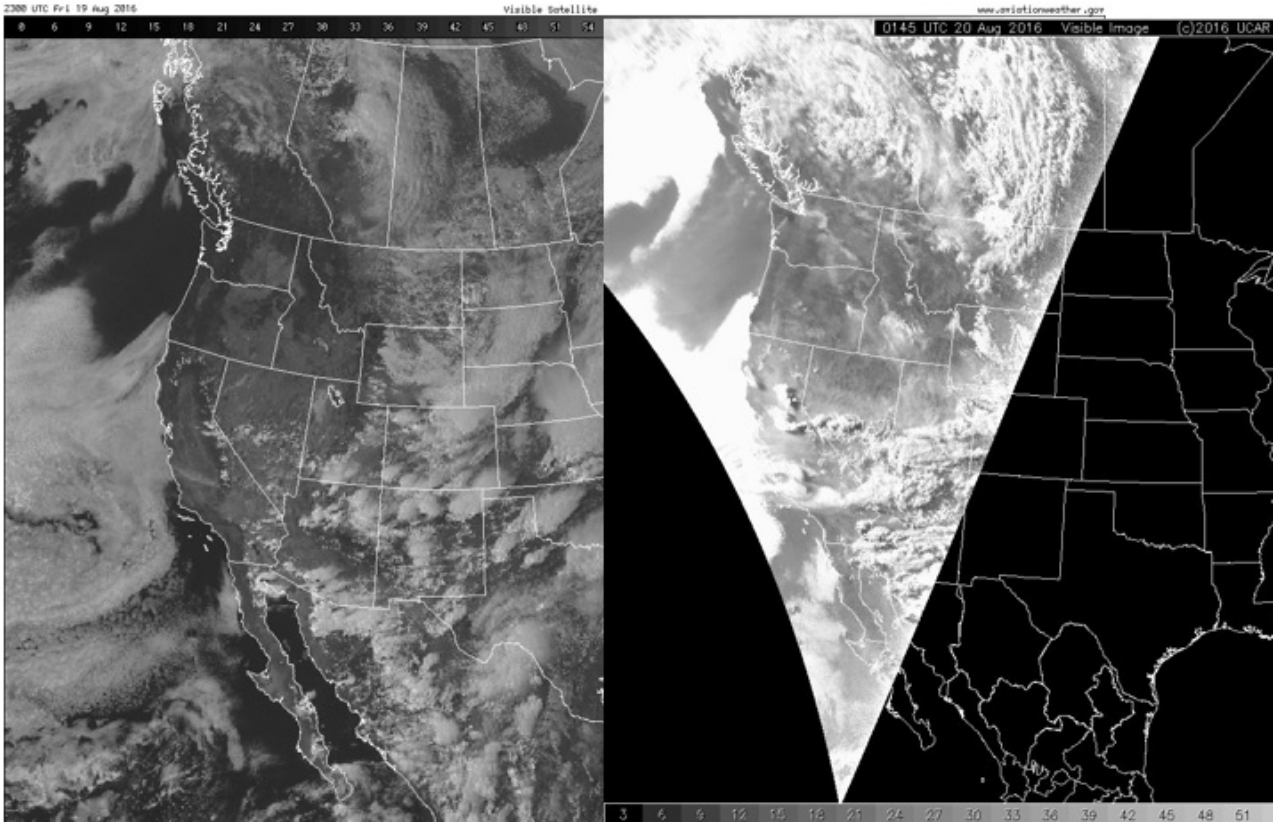


Fig 2-21: Visible satellite images show thunderstorms growing in northern Mexico near the international border, and into southern Arizona. The storms were a result of warmer air at the surface and cooler air above. Gusty outflow winds across Imperial County and southern Arizona were the result. Left image at 1500 PST August 19, 2016. Source: https://aviationweather.gov/: Mesoscale and Microscale Meteorology Division of NCAR. Right image is at 1745 PST August 19, 2016. Source: http://weather.rap.ucar.edu/satellite

FIGURE 2-22
SOUTHERLY WIND ACROSS SOUTHEAST CALIFORNIA AUGUST 19, 2016

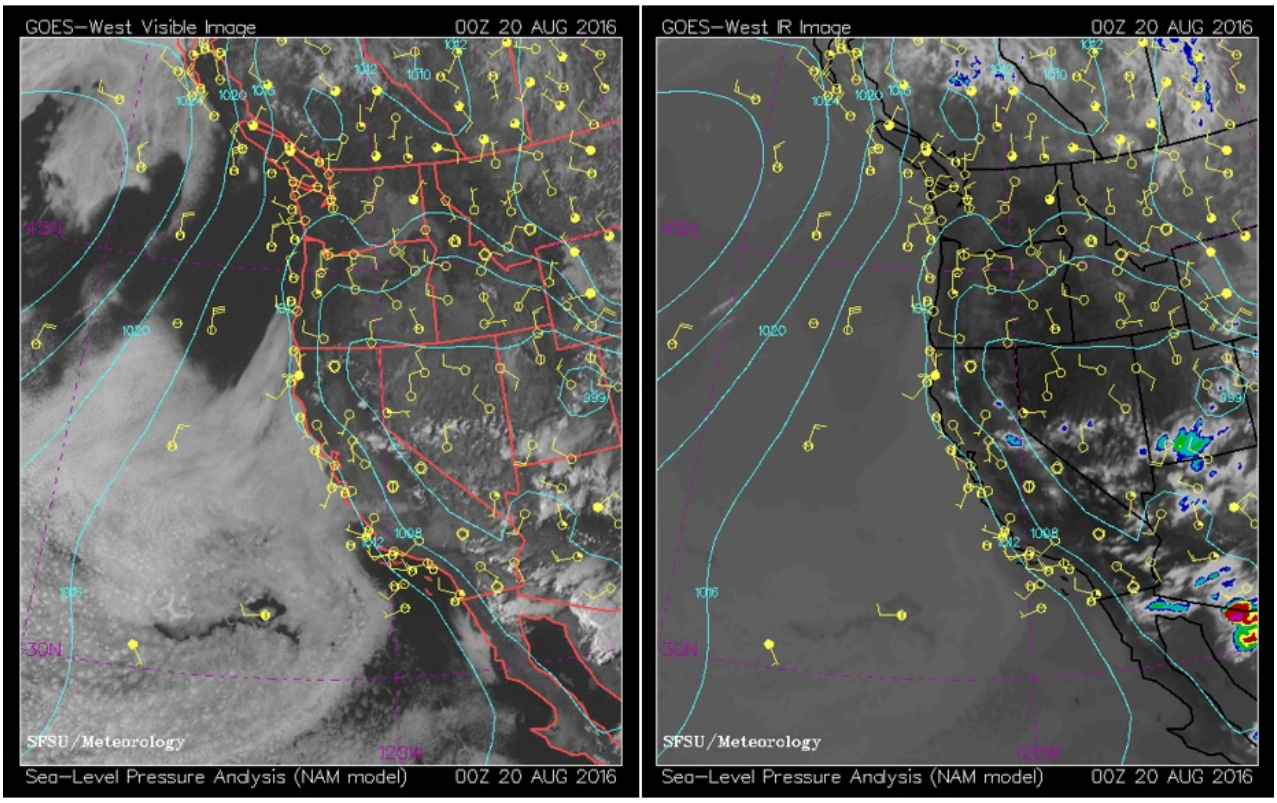


Fig 2-22: A pair of GOES-W satellite images (visible, left; infrared, right) overlaid with wind barbs illustrating southerly winds. Although the wind barbs indicate light winds around the time of this image (1600 PST), actual surface winds elevated the following hour (1700 PST). Source: http://weather.rap.ucar.edu/satellite; SFSU Department of Earth and Climate Sciences and the California Regional Weather Server; http://squall.sfsu.edu/crws/archive/wcsathts_arch.html

FIGURE 2-23
STRONG STORM CELLS OVER IMPERIAL COUNTY AUGUST 19, 2016

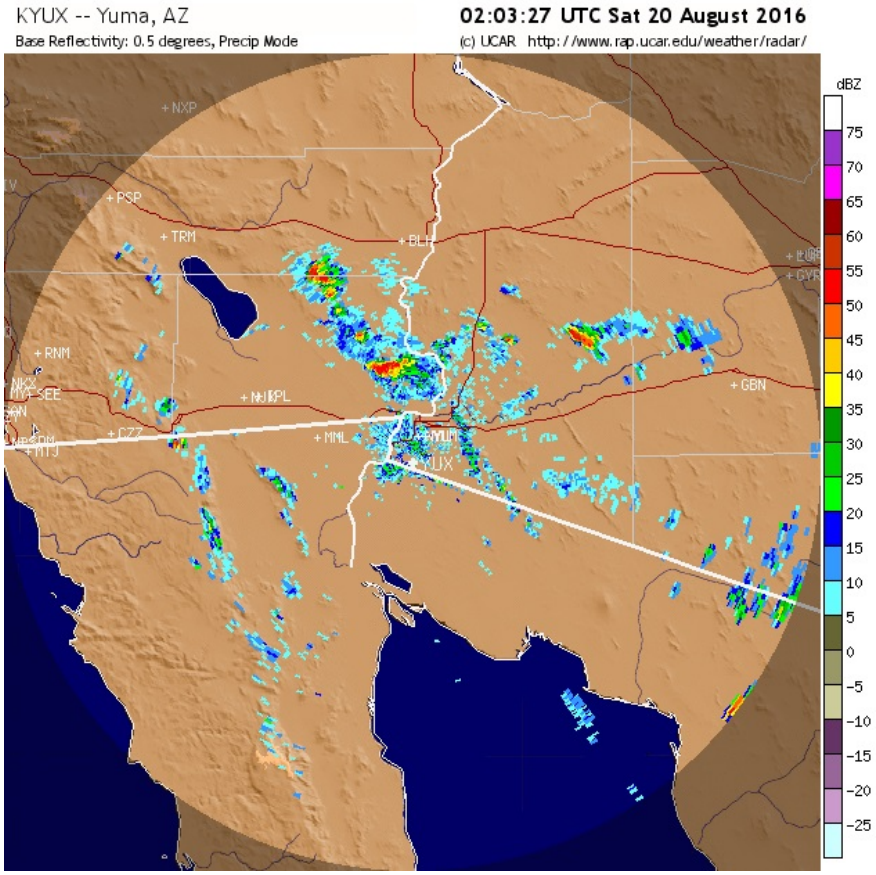


Fig 2-23: The NEXRAD radar station (KYUX) in Yuma, Arizona captured several strong storm cells over Imperial County at 1803 PST on August 19, 2016. Although this one hour prior to peak concentrations, a Dust Storm Warning for Imperial County was still in effect at the time. Source: http://weather.rap.ucar.edu/satellite

FIGURE 2-24
MONSOONAL AIR ON THE CA-AZ BORDER AUGUST 20, 2016

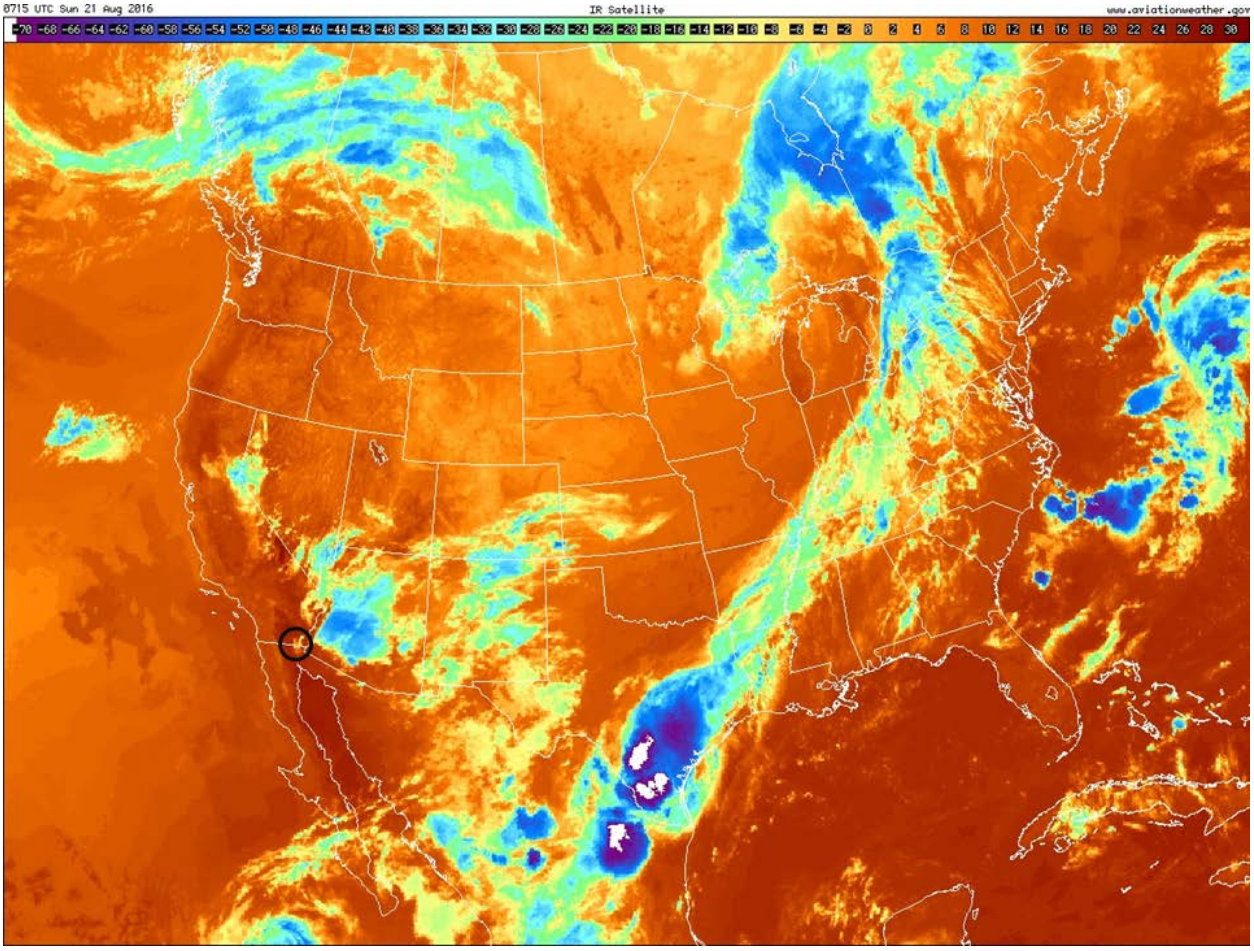


Fig 2-24: A CONUS infrared satellite image captured at 2315 PST on Aug 20, 2016 provides surface temperature indications for the continental United States. Clouds that are very high in the atmosphere are cold (blue) while clouds closer to the surface are warmer (lighter colors). Hotter surface temperatures and cooler sinking air can produce a "break" in the monsoon system preventing thunderstorms from forming in isolated areas. Although thunderstorms may not develop, gusty winds continue to occur under these meteorological conditions. Because of the weak low-pressure system off the Southern California coast moisture continued to enter the desert southwest affecting Imperial County (black circle) when less than typical monsoonal activity created erratic gusty winds. The Phoenix NWS office identified big mountain storms developing rapidly along the Mogollon Rim with strong southward moving gust-fronts followed by secondary convection so that by 1900 PST (2000 MST), August 20, 2016 broad southwest gust-front storms were forming near Blythe along the Colorado River.[16] The outflow boundary winds from these storms would affect Imperial County air quality August 21, 2016. The image above captured the clouds associated with the monsoonal moisture along the CA-AZ border. Source:
http://www2.mmm.ucar.edu/imagearchive/index.html

[16] Area Forecast Discussion National Weather Service, Phoenix AZ, 745 PM PST (845 PM MST) Saturday August 20, 2016

FIGURE 2-25
EVENING THUNDERSTORMS OVER ARIZONA AUGUST 20, 2016

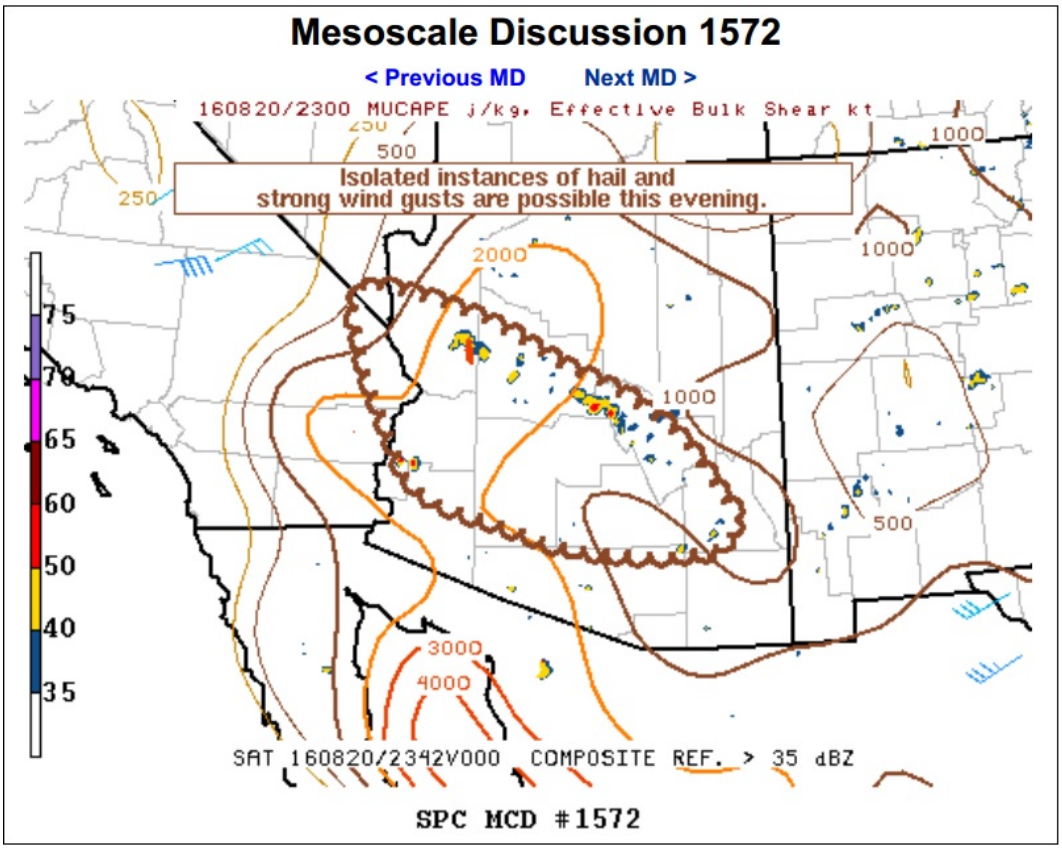


Fig 2-25: Although the weak steering flow aloft (**Figure 2-19**) favored a westerly direction below 17mph, the Phoenix NWS forecast a "pac-man" scenario where convection along the Mogollon Rim and southeast Arizona would send outflow westward reaching the Lower Colorado River valley by late evening August 20, 2016.[17] The overall western Conus flow pattern remained essentially the same as the past several days with high amplitude ridging folding into the Pacific Northwest and positively tilted trough relatively stationary to the south over the region. By early morning, August 21, 2016 the forecast outflow from the thunderstorms over Arizona reached Imperial County and the eastern San Diego County deserts after midnight.[18]
Source: http://www.spc.noaa.gov/exper/archive/event.php?date=20160524

[17] Area Forecast Discussion National Weather Service Phoenix AZ, 100 PM PST (200 PM MST) Saturday, August 20, 2016
[18] Area Forecast Discussion National Weather Service San Diego CA, 227 AM PST (327 AM PDT), Sunday, August 21, 2016

FIGURE 2-26
LOW PRESSURE OVER REGION AUGUST 21, 2016

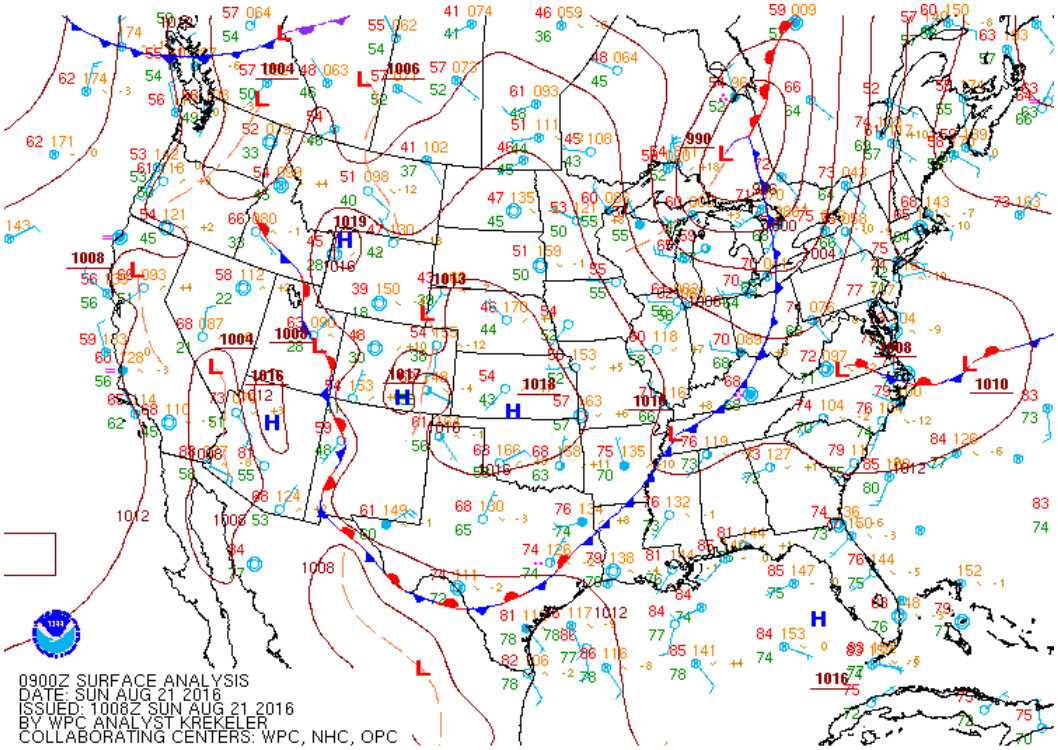


Fig 2-26: A surface analysis map (0100 PST August 21, 2016) shows a low pressure sagging southward from Nevada over the CA-AZ border. The weak upper level circulation over the lower Colorado River Valley brought high clouds, a few sprinkles and locally gusty erratic winds. Source: NWS Weather Prediction Center

FIGURE 2-27
GOES SATELLITE AUGUST 20, 2016 AND AUGUST 21, 2016

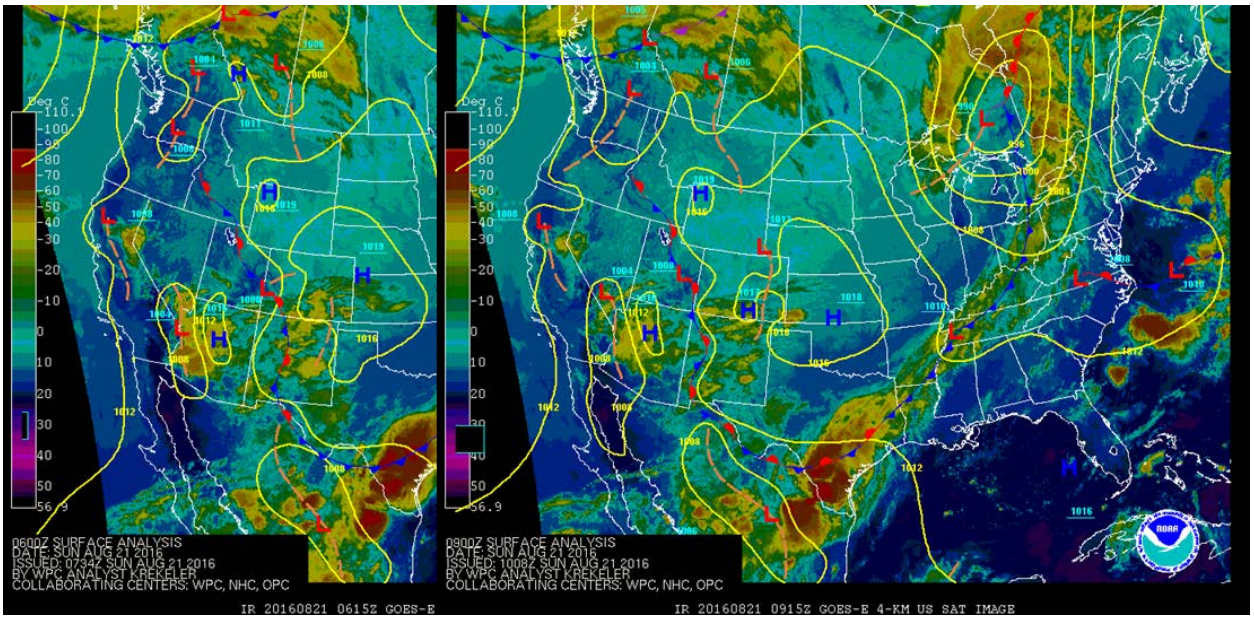


Fig 2-27: Two GOES-E 4km infrared satellite images captured at 2215 PST on August 20, 2016 (left image) and 0115 PST August 21, 2016 (right image) illustrates the position of the clouds and associated moisture levels during the evening hours of August 20, 2016 and the afternoon hours of August 21, 2016. All monitors in Imperial County measured elevated concentrations above 100 µg/m^3 during the 2300 PST hour of August 20, 2016 and continuous hourly concentrations above 100 µg/m^3 during the early morning hours of August 21, 2016. Source: WPC Surface Analysis Archive

FIGURE 2-28
AREAS IDENTIFIED BY THE NWS AFFECTED BY THUNDERSTORMS
ON AUGUST 19, 2016 AND AUGUST 21, 2016

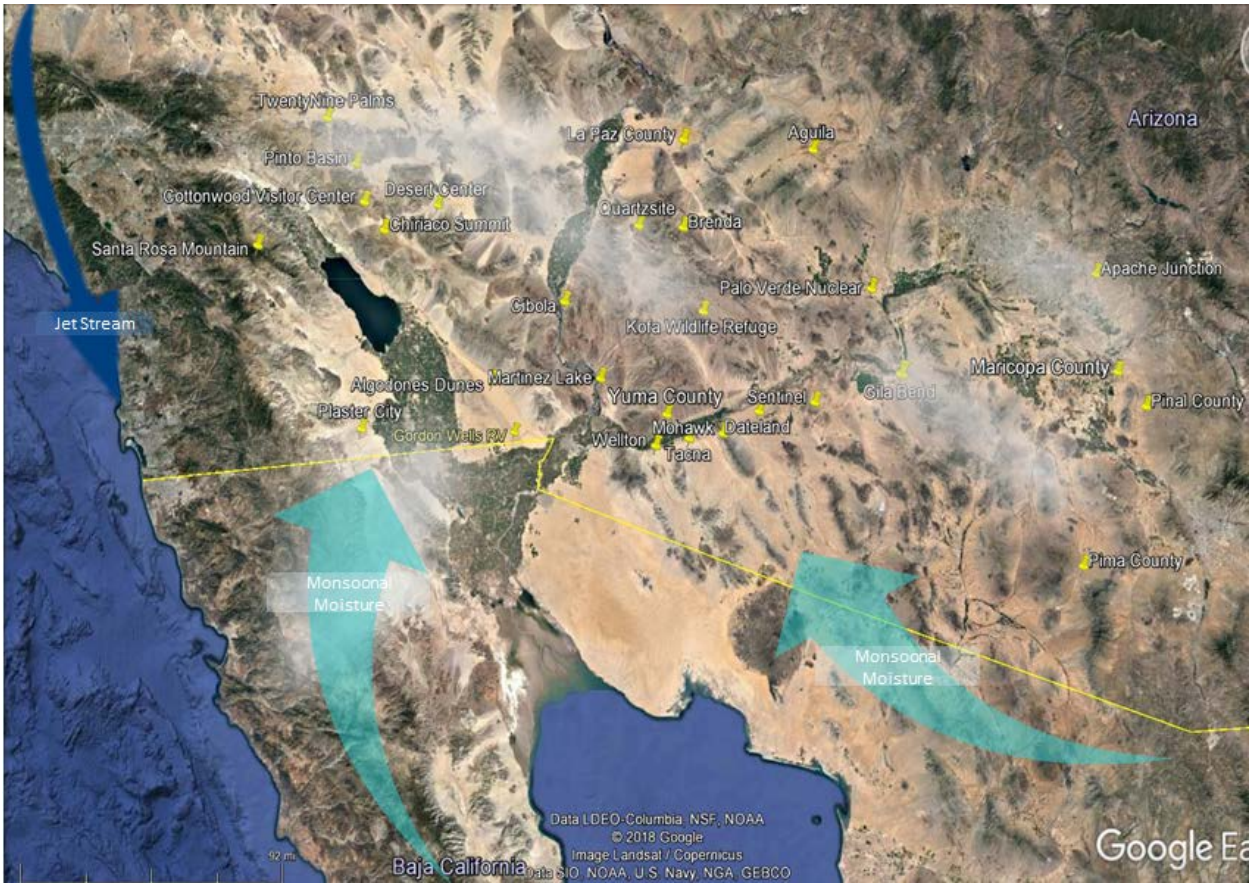


Fig 2-28: The National Weather Service issued no less than 126 notices as either Flood Advisories, Flood Warnings, Urgent Weather Messages, Special Weather Statements, Bulletins, Preliminary Storm reports, and Severe Weather Statements that identified areas affected by thunderstorm activity on August 19, 2016 and August 21, 2016. Source: Phoenix and San Diego NWS office

As discussed above, monsoonal moisture, the formation of a Pacific ridge over Southern California and a trough near the central California coast allowed a series of shortwaves reinforced by the jet stream to create dry gusty winds within the San Diego Mountains and deserts providing a gradual cooling of temperatures conducive for the intrusion of moisture from the south.

During the course of a few days, a weak area of upper level low-pressure moved ever so slowly, almost stationary in a southerly direction towards the coastal waters of southern California allowing sufficient moisture into the desert southwest. Convective cells that formed over the Santa Rosa Mountains and within the mountains of northern Baja California triggered short-lived, isolated thunderstorm through Friday, August 19, 2016. The meteorological conditions observed over the past few days remained unaltered through the early morning hours of August 21, 2016. This allowed residual mid-level monsoonal moisture to continue to move in from the east while

instability to the south in northern Mexico created by higher surface humidity allowed for the development of short-lived thunderstorm activity. Outflow boundaries from thunderstorm development from the east and from the south affected the desert southwest on August 21, 2016, which affected air quality and caused an exceedance at the Brawley, El Centro and Westmorland monitors.

Locally, winds were similarly short-lived and erratic. Beginning on August 18, 2016, the highest measured winds occurred between the hours of 0557 PST through the evening hours at the Yuma MCAS, Blythe Airport, and the Imperial County Airport. All airports measured at least three hours of wind gusts above 17mph. On August 19, 2016, the Yuma MCAS measured intermittent moderate level winds while the Imperial County Airport measured moderate to high winds from 853 PST through 2353 PST. The El Centro NAF measured elevated winds during the evening hours from 1700 PST through 2356 PST. The strongest measured winds on August 19, 2016 occurred at 1700 PST with winds gusts ranging between 26 and 40 mph during the 1700 PST hour. On August 20, 2016, winds remained moderate at the Yuma MCAS with the highest winds measured during the evening hours. While the Blythe Airport measured, continued moderate level winds throughout the day the Imperial County Airport and the El Centro NAF measured elevated winds only during the evening hours through the early morning hours of August 21, 2016. The Yuma MCAS similarly measured elevated winds during the morning hours of August 21, 2016.

In northern Mexico, the available data indicated that winds were equally elevated such as at the Laguna Salada (Constitución de 1857/Laguna Hanson), west of Imperial County. To the south and southeast of Imperial County elevated winds and gusts measured in Mexicali, the Mexicali Airport and San Luis Rio Colorado all are consistent with short intermittent elevated winds and gusts.

In all instances, these winds while short-lived and erratic where sufficient to allow windblown dust to affect air quality in Imperial County and cause an exceedance at the Brawley and Westmorland monitors on August 19, 2016 and the El Centro monitor on August 21, 2016. The thunderstorms that developed along the Imperial and San Diego County lines on August 19, 2016 would have allowed sufficient moisture to keep windblown dust from causing an exceedance at the Calexico, El Centro, and Niland monitors. All monitors on August 19, 2016 measured above 100 $\mu g/m^3$. As the primarily stationary weak upper low off the California coast and the jet stream continued to influence the convergence of monsoonal moisture within the desert southwest, shortwaves continued to cause additional thunderstorm development within southwestern Arizona and northern Mexico. Sufficient moisture from these thunderstorms allowed for windblown dust from outflow boundaries to cause elevated concentrations above 100 $\mu g/m^3$ but below an exceedance level except at the El Centro monitor.

Figures 2-29 and 2-30 depict the ramp-up analysis for August 19, 2016 and August 21, 2016. The figures provide a visual depiction of the meteorological conditions that existed when a weak upper level low off the California coast and the jet stream influenced the convergence of moisture allowing several shortwaves to develop creating short-lived and erratic thunderstorm activity along the desert southwest within southwestern Arizona and southeastern California.

FIGURE 2-29
RAMP-UP ANALYSIS AUGUST 19, 2016

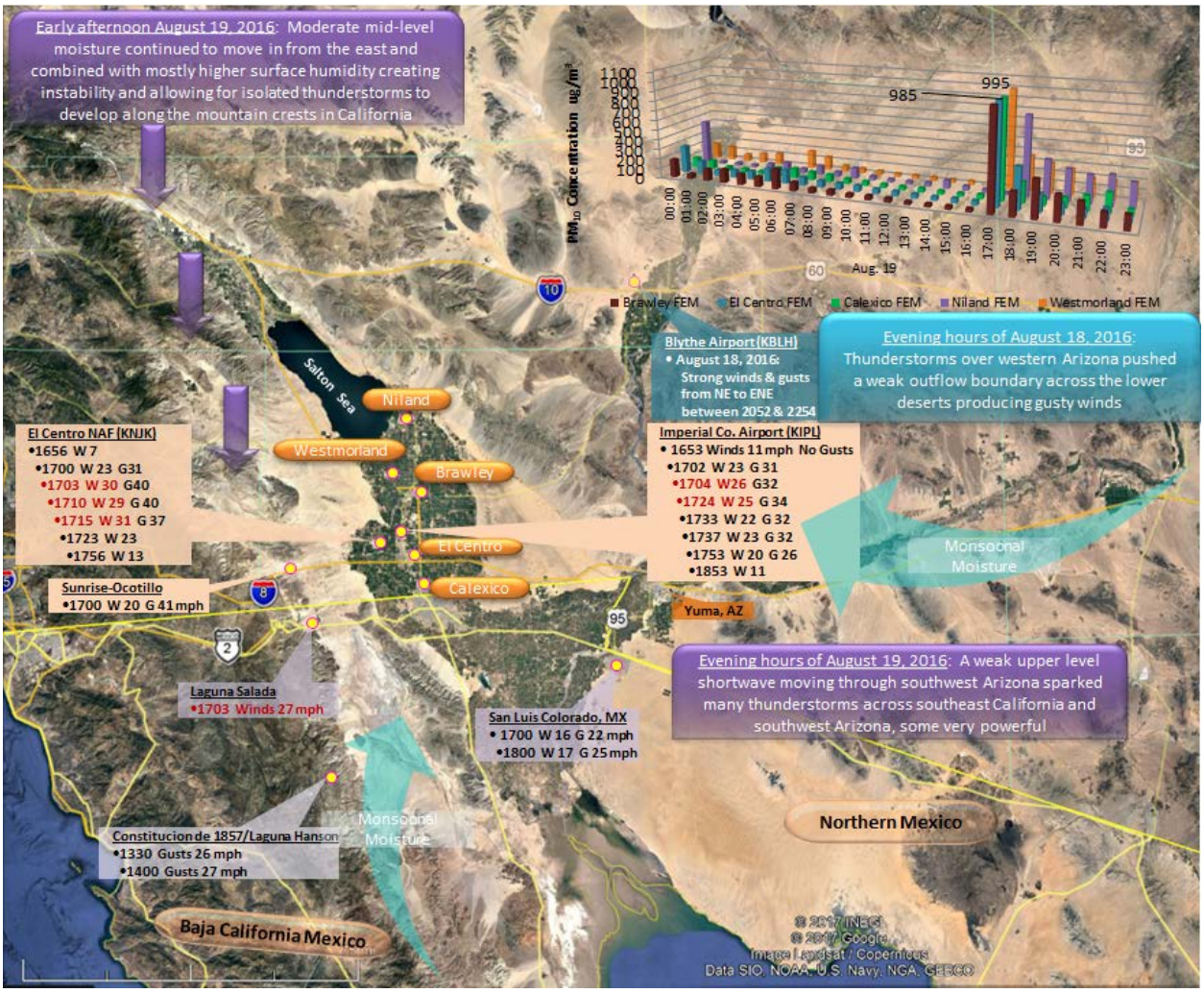


Fig 2-29: Both the Phoenix and San Diego NWS offices described a trough in California with westerly mid/upper winds and several shortwaves that allowed for convection in Arizona. As a result southeast California to south central Arizona came under increasing upper level cyclonic shear as the Jetstream moved further south of the border into Mexico. During the early morning hours of August 19, 2016, thunderstorms over western Arizona pushed a weak outflow boundary across the lower deserts. Storms mostly formed over the crests early afternoon where surface convergence occurred. The convergence moved east into the deserts affecting the San Diego, Imperial County line late afternoon.[19] Descriptions of the evening activity for August 18, 2016 is found in issued Urgent Weather Messages during the late evening hours of August 18, 2016 and Area Forecast Discussion issued early morning August 19, 2016. Google Earth base map

[19] Area Forecast Discussions from the National Weather Service office in San Diego CA, 217 AM PST (317 AM PDT); San Diego CA, 100 PM PST (200 PM PDT); Phoenix AZ, 750 PM PST (850 PM MST), Friday, August 19, 2016

FIGURE 2-30
RAMP-UP ANALYSIS AUGUST 21, 2016

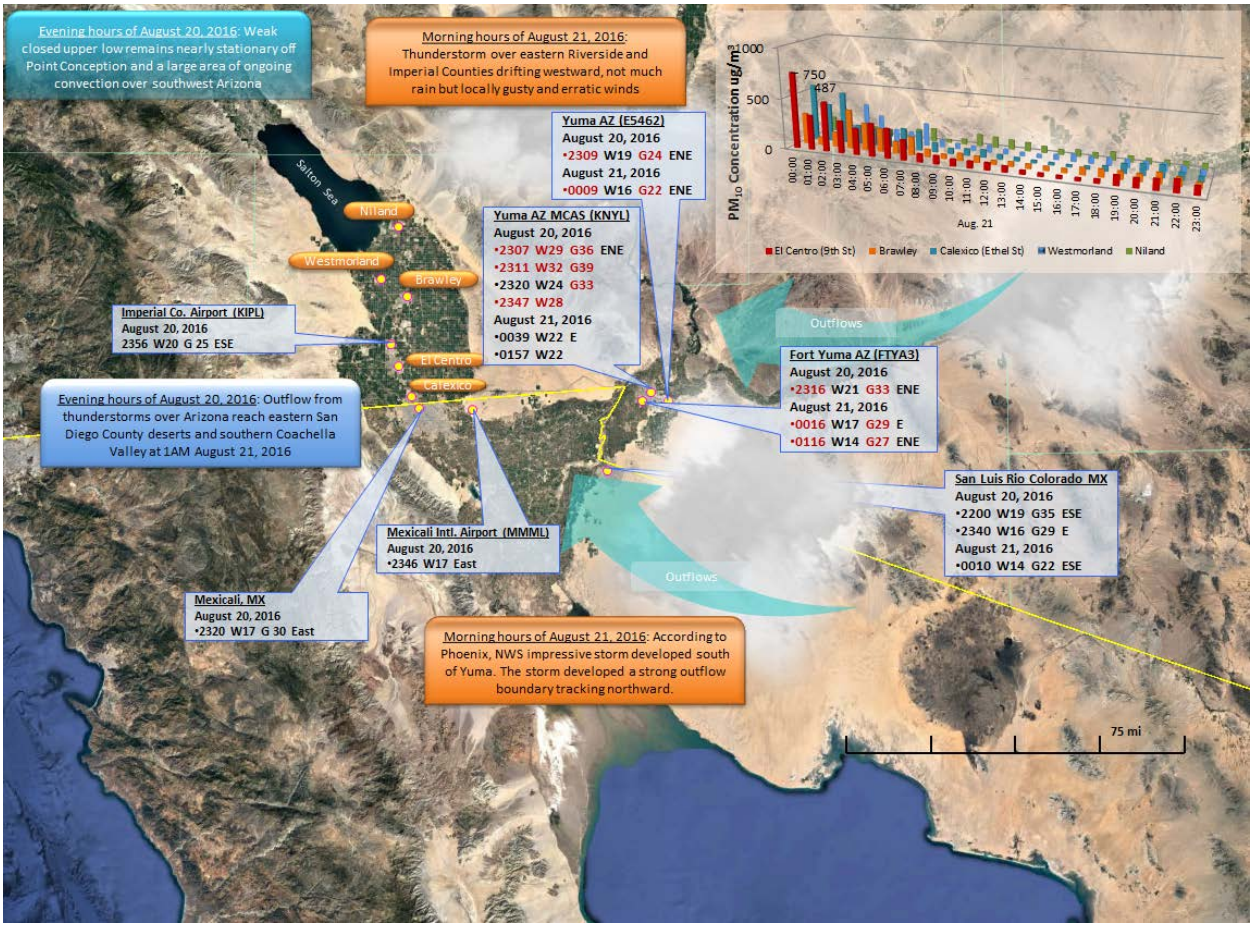


Fig 2-30: According to early morning forecast by the Phoenix NWS office for August 20, 2016, a "pac-man" scenario where rim convection and southeast Arizona mountain convection would both send outflows westward potentially, creating strong convection that would eventually reach the Lower Colorado River Valley. As the upper level trough in California remained relatively stationary, convection continued over most of central Arizona. With the unstable air mass over Yuma County, created days prior, outflow from thunderstorms over Arizona managed to reach eastern Riverside and Imperial Counties shortly after midnight August 21, 2016. These storms drifted westward towards the San Bernardino Mountains while a rather impressive storm developed south of Yuma with outflow tracking northward.[20] Google Earth base map

[20] Area Forecast Discussions from the National Weather Service office in Phoenix AZ, 745 PM PST (845 PM MST); San Diego CA, 817 PM PST (917 AM PDT) Saturday, August 20, 2016 and Area Forecast Discussions San Diego CA, 227 AM PST (327 AM PDT); San Diego, 754 PM PST (854 PM PDT); Phoenix AZ, 1256 PM PST (156 PM MST), Sunday, August 21, 2016

Table 2-2 contains a summary of maximum winds, peak wind gusts, and wind direction at monitors in Imperial County, eastern Riverside County, Yuma County, Arizona, and Mexicali. For detailed meteorological station, graphs see **Appendix B**.

TABLE 2-2

WIND SPEEDS ON AUGUST 19, 2016 AND AUGUST 21, 2016

Station Monitor		Maximum Wind Speed (WS) (mph)	Wind Direction during Max WS (degrees)	*Time of Max Wind Speed	24 hr Maximum Wind Gust (WG) (mph)	Time of Max WG	PM_{10} correlated to time of Max Wind Speed				
Airport Meteorological Data	Day						Brly	CX	EC	Nlnd	Wstmld
IMPERIAL COUNTY											
Imperial Airport (KIPL)	19	26	200	17:04	34	17:24	995	985	995	26	995
	21	11	120	0:53	21	10:53	307	552	750	141	353
Naval Air Facility (KNJK)	19	31	180	17:15	40	17:03	995	985	995	26	995
	21	15	80	7:56	-	-	179	187	199	127	229
Calexico (Ethel St)	19	10.4	211	17:00	-	-	995	985	995	26	995
	21	10.1	119	0:00	-	-	307	552	750	141	353
El Centro (9th Street)	19	11.4	205	17:00	-	-	995	985	995	26	995
	21	10.3	47	7:00	-	-	179	187	199	127	229
Niland (English Rd)	19	20.5	65	0:00	-	-	184	100	275	449	161
	21	12.1	140	0:00	-	-	307	552	750	141	353
Westmorland	19	8.9	154	23:00	-	-	148	61	77	254	194
	21	10	141	0:00	-	-	307	552	750	141	353
RIVERSIDE COUNTY											
Blythe Airport (KBLH)	19	20	180	22:52	-	-	147	197	117	305	194
	21	21	250	6:41	26	16:52	118	200	292	104	129
Palm Springs Airport (KPSP)	19	20	320	15:53	26	16:53	34	34	45	45	37
	21	7	300	5:53	-	-	324	179	324	72	138
Jacqueline Cochran Regional Airport (KTRM) - Thermal	19	10	120	16:52	17	11:52	33	43	44	34	40
	21	14	120	1:52	-	-	342	370	342	54	97
ARIZONA - YUMA											
Yuma MCAS (KNYL)	19	22	210	17:57	-		995	985	995	26	995
	21	22	100	1:57	-	-	342	370	342	54	97
MEXICALI - MEXICO											
Mexicali Int. Airport (MXL)	19	14	120	16:45	-	-	33	43	44	34	40
	21	16.1	50	7:49	-	-	199	187	199	127	229

*All time referenced throughout this document is in Pacific Standard Time (PST) unless otherwise noted

The National Oceanic and Atmospheric Administration (NOAA) Air Resources Laboratory HYSPLIT back trajectory models,[21] depicted in **Figures 2-31 and 2-32** depict the general path of airflow 12 hours prior to 1700 PST, August 19, 2016 and 12 hours prior to 000 PST on August 21, 2016. The 1700 PST hour is coincident with elevated wind speeds, wind gusts and peak hourly measured concentrations at all monitors except at the Niland monitor. The 0000 PST hour is coincident with elevated winds to the south of Imperial County and in Yuma and hourly peak concentrations at the monitors located in El Centro, Calexico and Niland. Generally, the HYSPLIT models depict the 10 and 100-meter level airflow along the surface while the 500-meter airflow remains above surface, more so on August 19, 2016. In addition, the HYSPLIT model for August 19, 2016 indicated that of the two exceeding monitors airflow at the surface had a predominant south to northwest direction while the non-exceeding monitors had a definitive south to southeast airflow consistent with the NWS descriptions of erratic winds. While the airflow on August 21, 2016 (**Figure 2-32**) was much more predictable, there still existed some erratic airflow consistent with the NWS descriptions of boundary outflows from thunderstorm activity. Data used in the HYSPLIT model has a horizontal resolution of 12 km and is integrated every three hours. Thus, the HYSPLIT model may differ from local observed surface wind speeds and directions and may not capture thunderstorm outflows.

[21] The Hybrid Single Particle Lagrangian Integrated Trajectory Model (**HYSPLIT**) is a computer model that is a complete system for computing simple air parcel trajectories to complex dispersion and deposition simulations. It is currently used to compute air parcel trajectories and dispersion or deposition of atmospheric pollutants. One popular use of HYSPLIT is to establish whether high levels of air pollution at one location are caused by transport of air contaminants from another location. HYSPLIT's back trajectories, combined with satellite images (for example, from NASA's MODIS satellites), can provide insight into whether high air pollution levels are caused by local air pollution sources or whether an air pollution problem was blown in on the wind The initial development was a result of a joint effort between NOAA and Australia's Bureau of Meteorology. Source: NOAA/Air Resources Laboratory, 2011.

FIGURE 2-31
HYSPLIT MODEL ALL STATIONS AUGUST 19, 2016

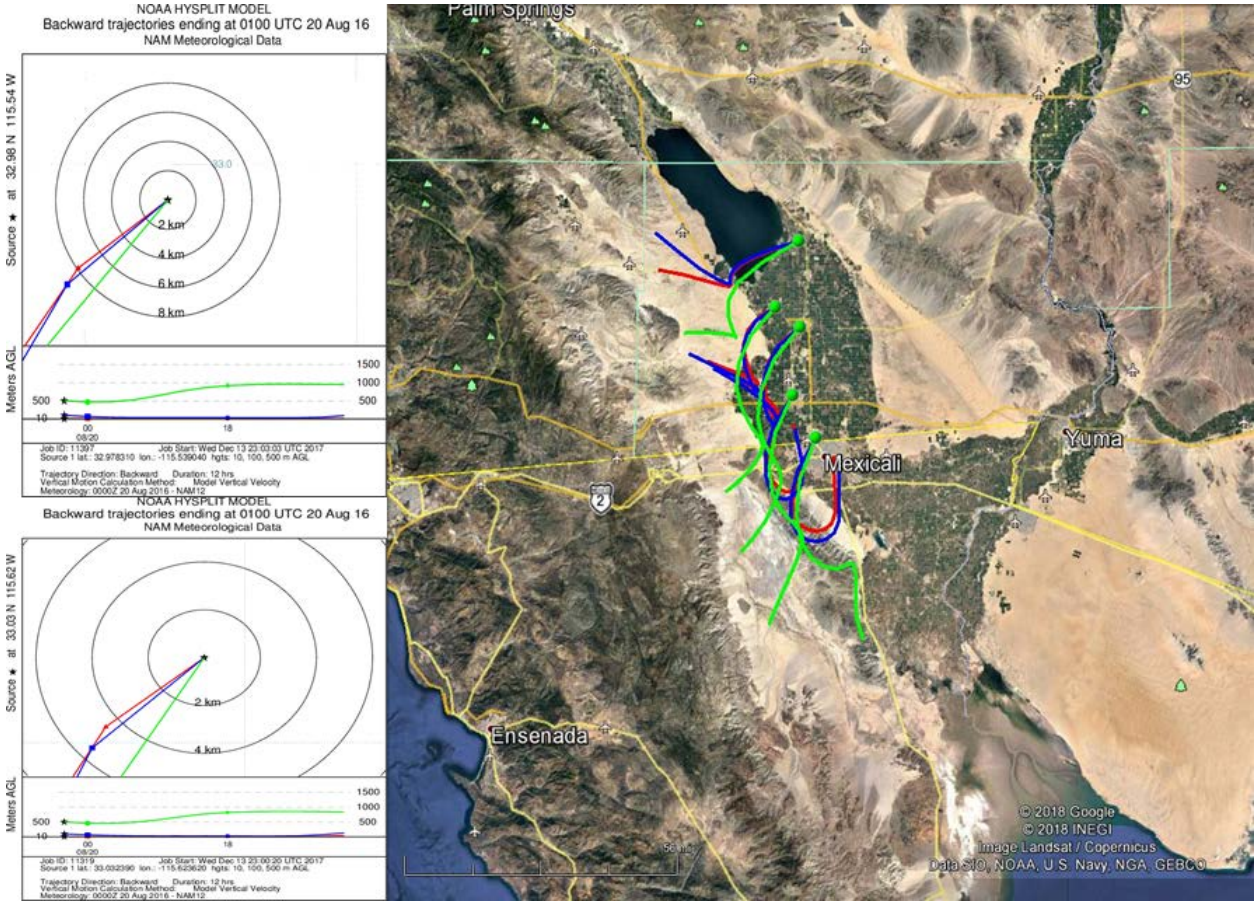


Fig 2-31: A 12-hour back-trajectory ending at 1700 PST on August 19, 2016 at all stations indicates airflow at exceeding monitors from a westerly direction while the non-exceeding monitors had a southerly direction. The HYSPLIT, similarly demonstrates the erractic nature of the airflow. The two HYSPLIT images to the left represent the Brawley monitor (top left) and the Westmorland monitor (bottom left). Red trajectory indicates airflow at 10 meters AGL (above ground level); blue indicates airflow at 100 m; green indicates airflow at 500m. Yellow line indicates the international border. Aqua lines denote county boundaries. Dynamically generated through NOAA's Air Resources Laboratory HYSPLIT model. Base map from Google Earth

FIGURE 2-32
HYSPLIT MODEL ALL STATIONS AUGUST 21, 2016

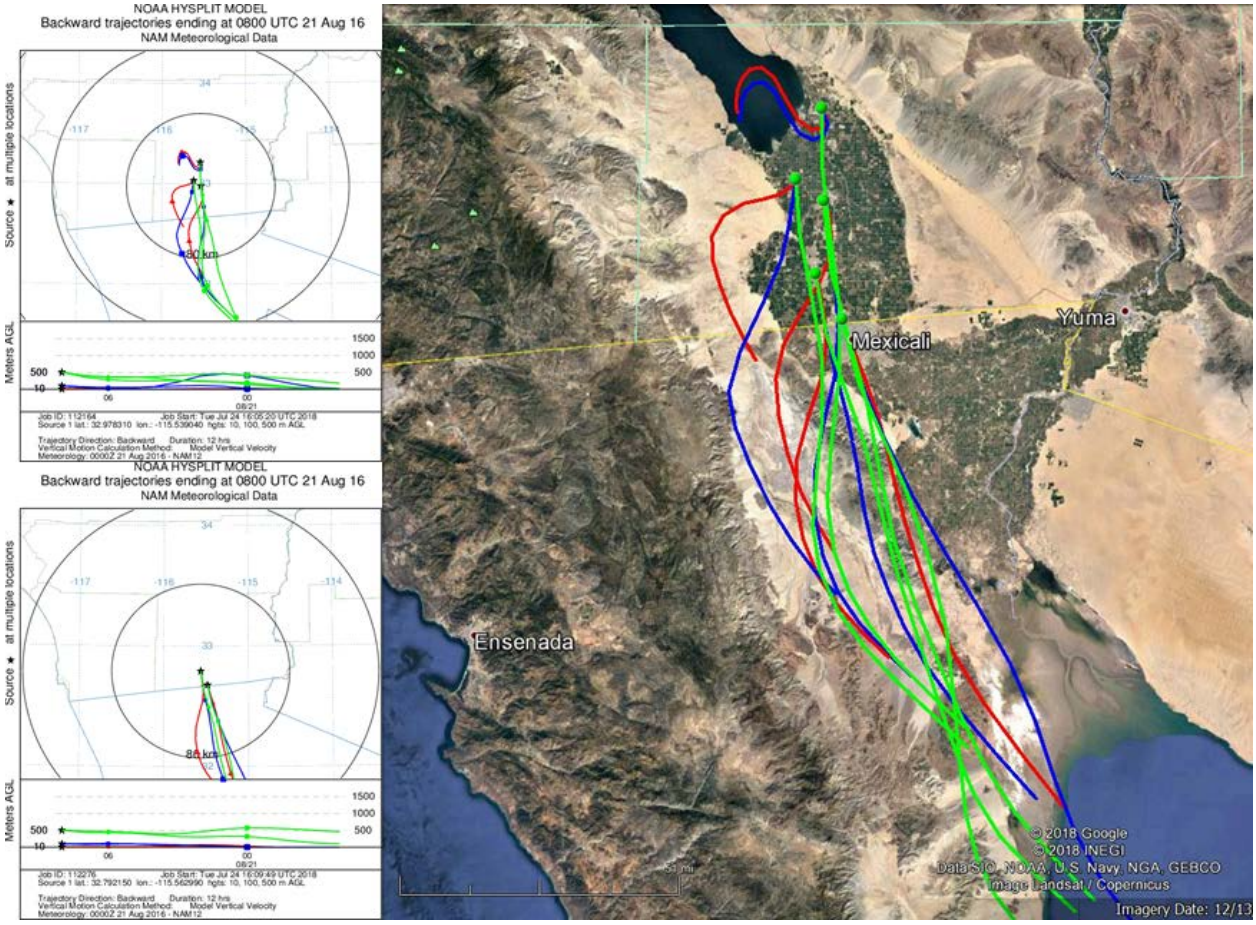


Fig 2-32: A 12-hour back-trajectory ending at 0000 PST on August 21, 2016 at all stations indicates airflow from a southerly direction. The two HYSPLIT images to the left represent the Brawley, Niland and Westmorland monitors (top left) and the El Centro and Calexico monitors (bottom left). Red trajectory indicates airflow at 10 meters AGL (above ground level); blue indicates airflow at 100 m; green indicates airflow at 500m. Yellow line indicates the international border. Aqua lines denote county boundaries. Dynamically generated through NOAA's Air Resources Laboratory HYSPLIT model. Base map from Google Earth

Figures 2-33 and 2-34 illustrate the elevated wind speeds and elevated levels of hourly PM_{10} concentrations measured in Riverside, Imperial and Yuma Counties for five days, August 18, 2016 through August 22, 2016. Elevated dust emissions transported into Imperial County affected air monitors when short-lived thunderstorms to the east and south of Imperial County caused erratic outflow boundary winds. These erratic winds affected the Brawley, Westmorland and El Centro monitors when short-lived intense winds associated with thunderstorm outflows swept northward out of Mexico and westward out of Arizona on August 19, 2016 and August 21, 2016. On August 19, 2016 and August 21, 2016, representative peak hourly measured concentrations coincided with elevated winds speeds above 25 mph, either as the actual hour of peak

measurement or the hour prior to the peak measurement.

FIGURE 2-33
WIND SPEEDS AT REGIONAL AIRPORTS

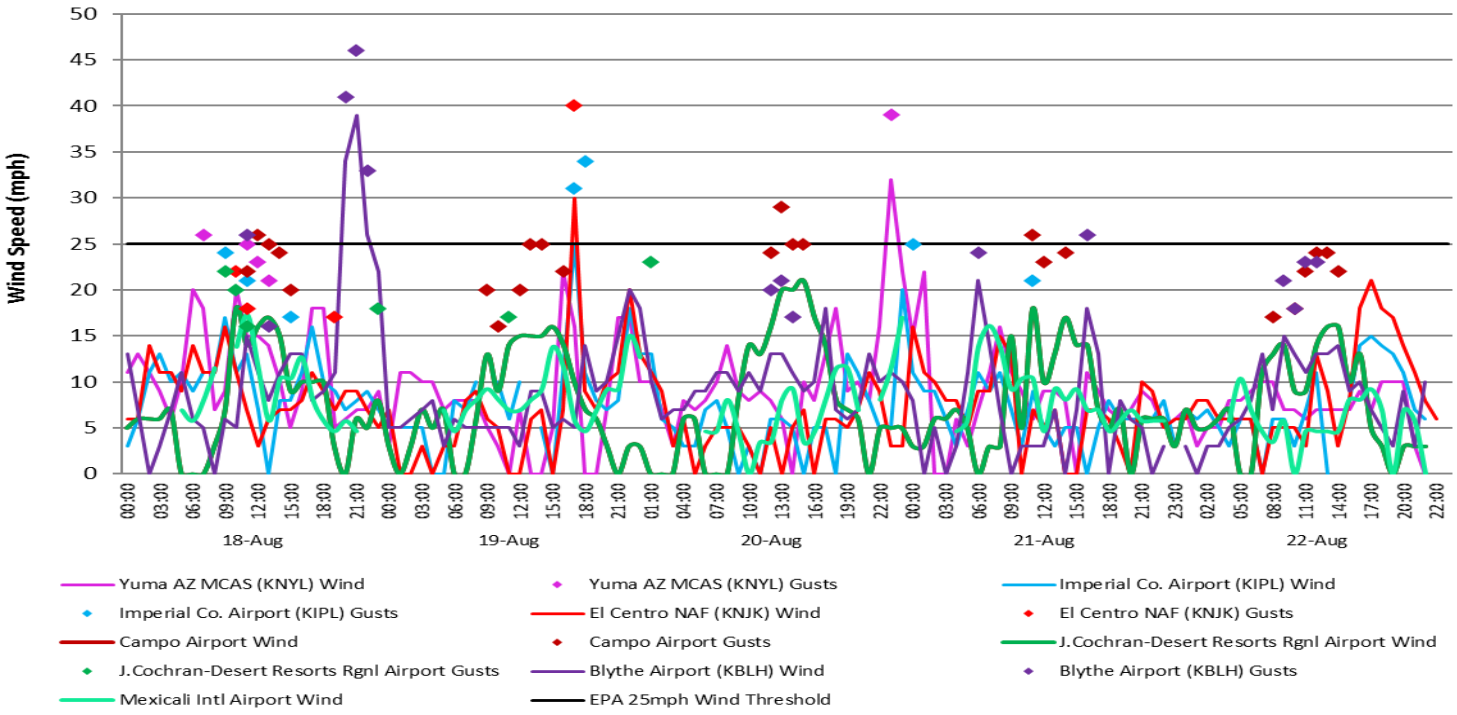


Fig 2-33: Is the graphical representation of the five day measured winds speeds and gusts at regional airports in California and Arizona. The graph illustrates the hourly measured winds speeds above the 25 mph threshold. The graph helps to substantiate the regional nature of the event. Wind Data from the NCEI's QCLCD system. Mexicali Airport from the University of Utah's MesoWest

FIGURE 2-34
PM_{10} CONCENTRATIONS AT VARIOUS SITES

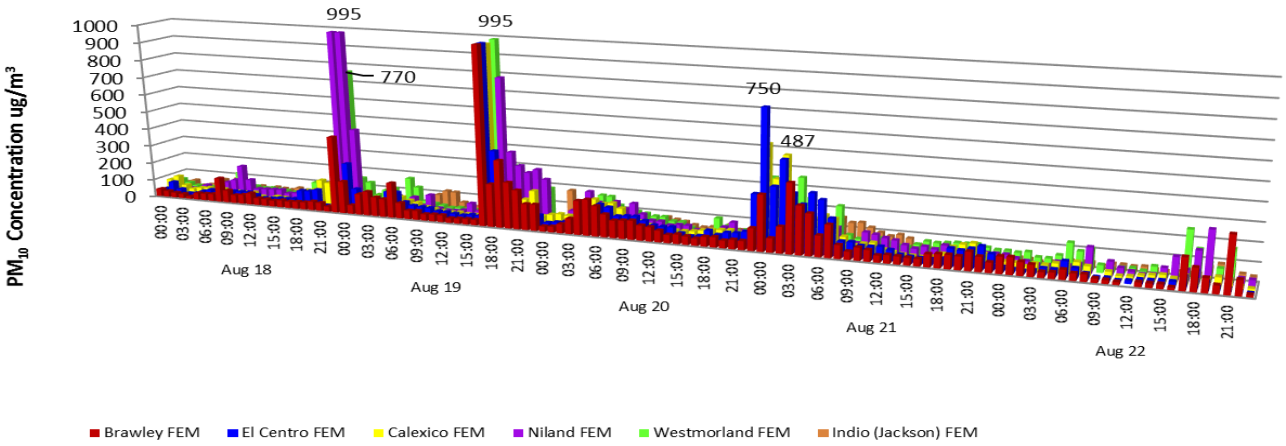


Fig 2-34: Is the graphical representation of the five-day relative PM_{10} concentrations at various sites in California. The elevated PM_{10} concentrations at all sites demonstrate the regional impact of the weather system and accompanying winds. Air quality data from the EPA's AQS data bank

III Historical Concentrations

III.1 Analysis

While naturally occurring high wind events may recur seasonally and at times frequently and qualify for exclusion under the EER, historical comparisons of the particulate concentrations and associated winds provide insight into the frequency of events within an identified area. The following time series plots illustrate that PM_{10} concentrations measured at the Brawley, Westmorland and El Centro monitors on August 19, 2016 and August 21, 2016, were compared to non-event and event days demonstrating the variability over several years and seasons. The analysis, also, provides supporting evidence that there exists a clear causal relationship between the August 19, 2016 and August 21, 2016 high wind event and the exceedance measured at the Brawley, Westmorland and El Centro monitors.

Figures 3-1 through 3-3 show the time series of available FRM and BAM 24-hr PM_{10} concentrations at the Brawley and Westmorland stations for the period of January 1, 2010 through August 19, 2016 and August 21, 2016. Note that prior to 2013, the BAM data was not considered FEM and was not reported into AQS.[22] In order to properly establish the variability of the event as it occurred on August 19, 2016 and August 21, 2016, 24-hour averaged PM_{10} concentrations between January 1, 2010 and August 19, 2016 and August 21, 2016 were compiled and plotted as a time series. All figures illustrate that the exceedance, which occurred on August 19, 2016 and August 21, 2016 were outside the normal historical concentrations when compared to event and non-event days. Air quality data for all graphs was obtained through the EPA's AQS data bank.

[22] Pollutant concentration data contained in EPA's Air Quality System (AQS) are required to be reported in units corrected to standard temperature and pressure (25 C, 760 mm Hg). Because the PM_{10} concentrations prior to 2013 were not reported into the AQS database all BAM (FEM) data prior to 2013 within this report are expressed as micrograms per cubic meter (mg/m3) at local temperature and pressure (LTP) as opposed to standard temperature and pressure (STP, 760 torr and 25 C). The difference in concentration measurements between standard conditions and local conditions is insignificant and does not alter or cause any significant changes in conclusions to comparisons of PM_{10} concentrations to PM_{10} concentrations with in this demonstration.

FIGURE 3-1
BRAWLEY HISTORICAL
FRM AND FEM PM_{10} 24-HR AVG CONCENTRATIONS
JANUARY 1, 2010 TO AUGUST 19, 2016

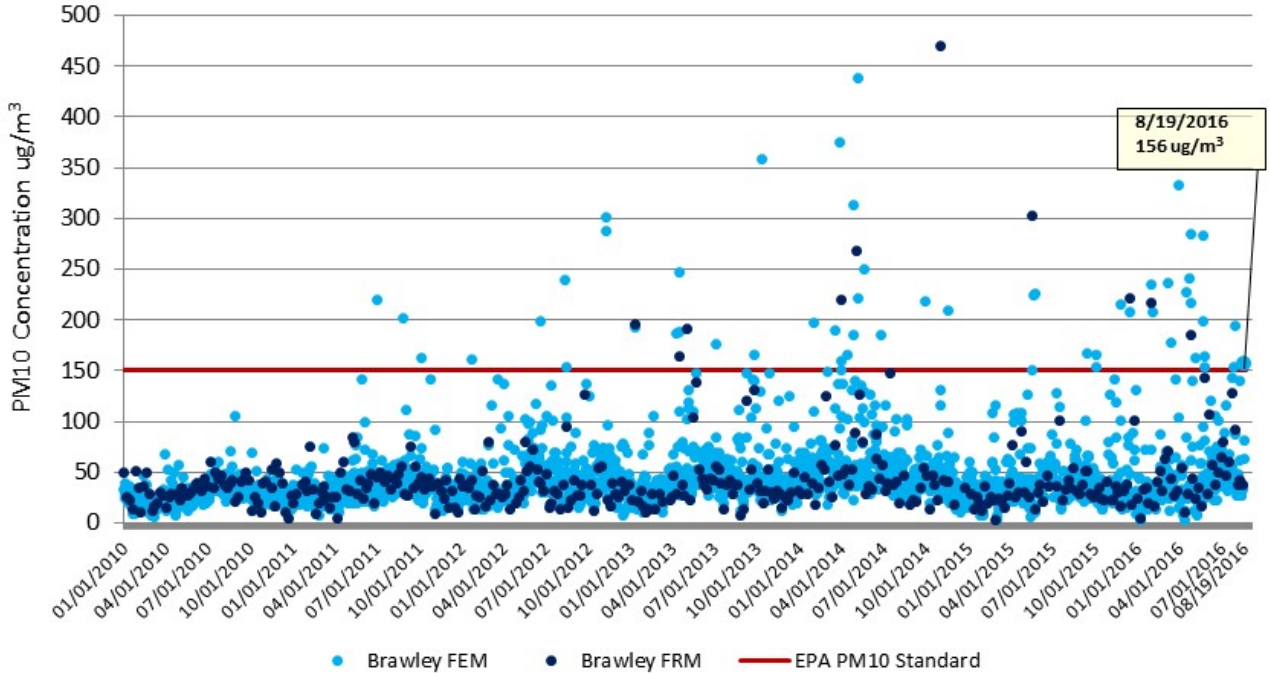


Fig 3-1: A comparison of PM_{10} historical concentrations demonstrates that the measured concentration of 156 µg/m^3 on August 19, 2016 by the Brawley monitor was outside the normal historical measurements

FIGURE 3-2
WESTMORLAND HISTORICAL
FRM AND FEM PM_{10} 24-HR AVG CONCENTRATIONS
JANUARY 1, 2010 TO AUGUST 19, 2016

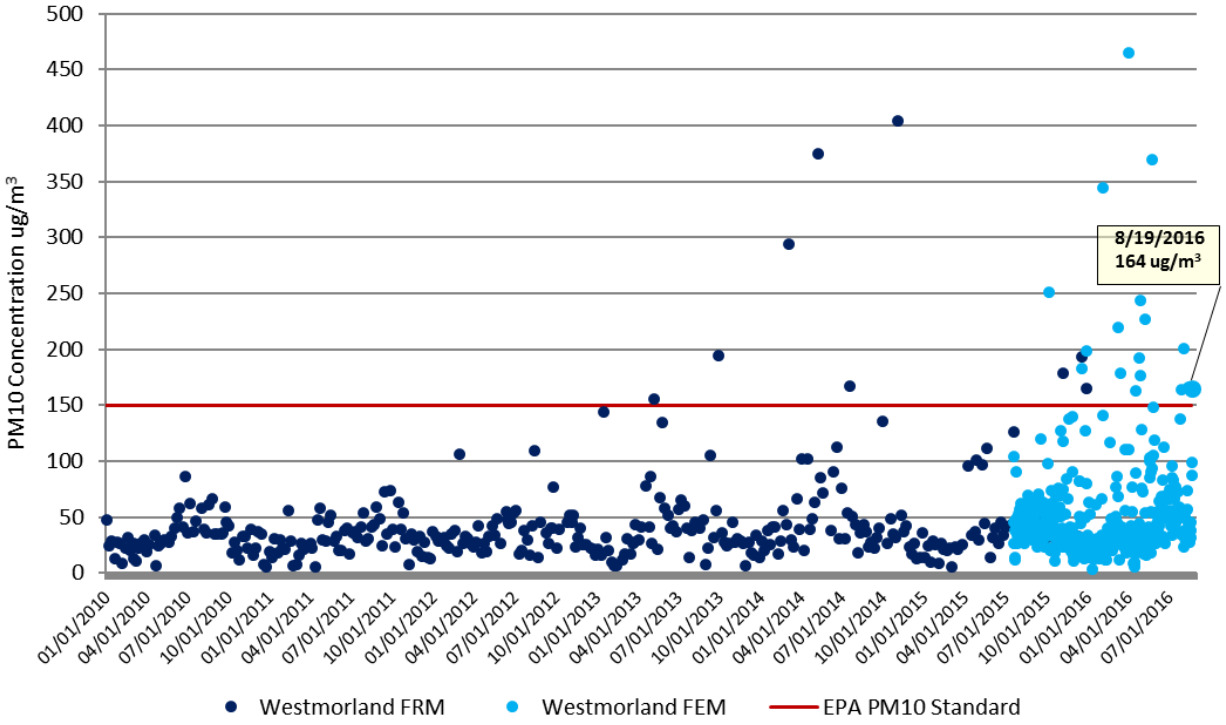


Fig 3-2: A comparison of PM_{10} historical concentrations demonstrates that the measured concentrations of 164 µg/m^3 on August 19, 2016 by the Westmorland monitor was outside the normal historical measurements

FIGURE 3-3
EL CENTRO HISTORICAL
FRM AND FEM PM_{10} 24-HR AVG CONCENTRATIONS
JANUARY 1, 2010 TO AUGUST 21, 2016

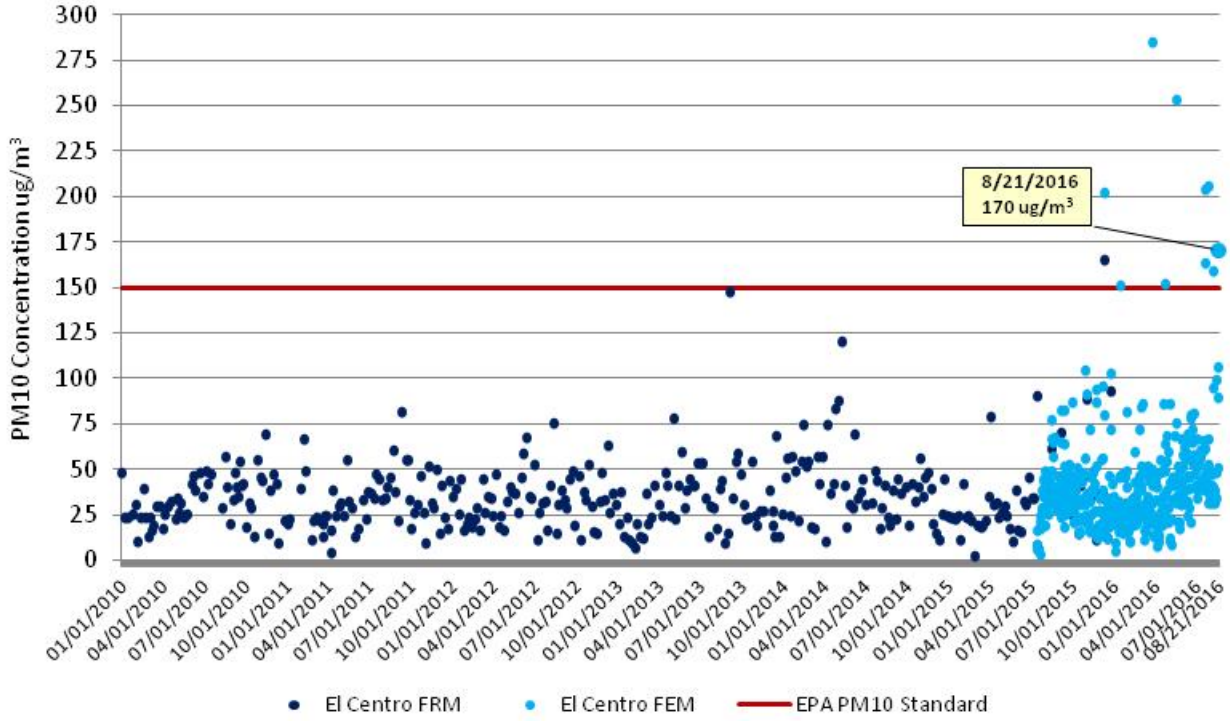
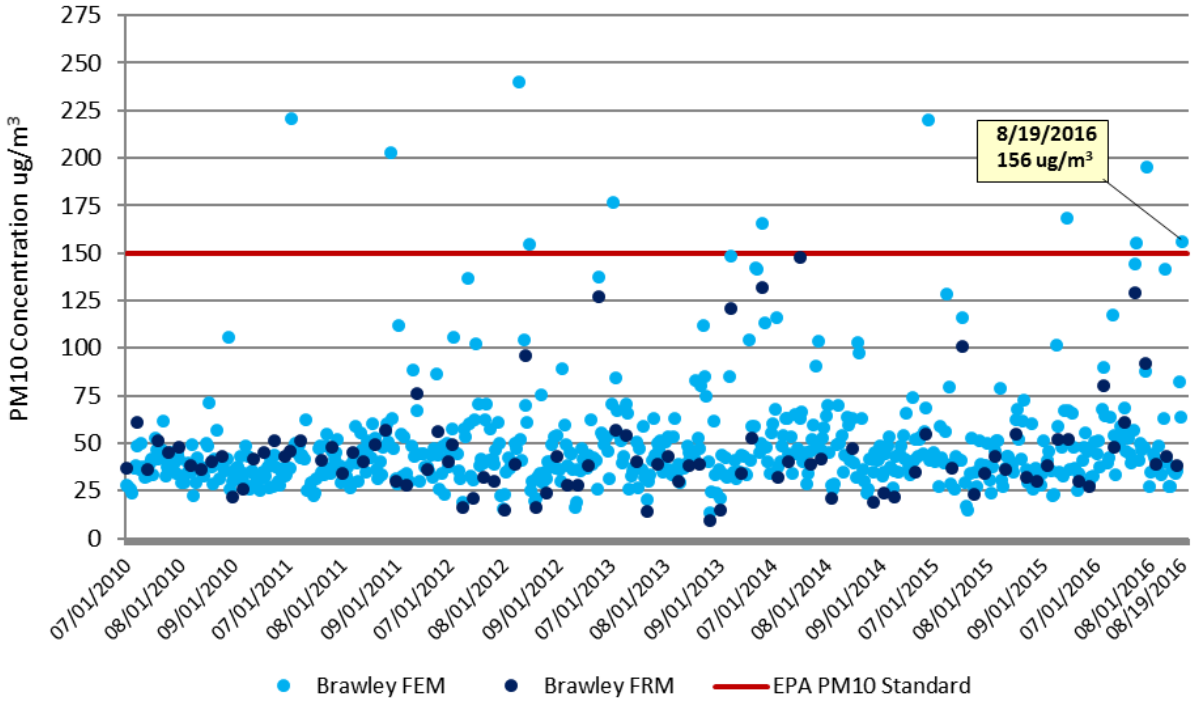


Fig 3-3: A comparison of PM_{10} historical concentrations demonstrates that the measured concentration of 170 µg/m^3 on August 21, 2016 by the El Centro monitor was outside the normal historical measurements.

The time series, **Figures 3-1 through 3-3** for Brawley, Westmorland and El Centro include 2,423 sampling days (January 1, 2010 through August 21, 2016). During this period the Brawley station (**Figure 3-1**) recorded 2,807 credible samples measured by either FRM or FEM monitors between January 1, 2010 and August 19, 2016. Overall, the time series illustrates that of the 2,807 credible samples measured during there was a total of 54 exceedance days, which is a 1.9% occurrence rate. Westmorland (**Figure 3-2**) recorded 758 credible samples measured by either FRM or FEM monitors during this period (FEM sampling commenced in July 2015) during which the station recorded 24 exceedance days. This translates into 3.2% of all samples. Clearly, exceedances by either the Brawley or Westmorland monitoring stations over a historical period is a rare event.

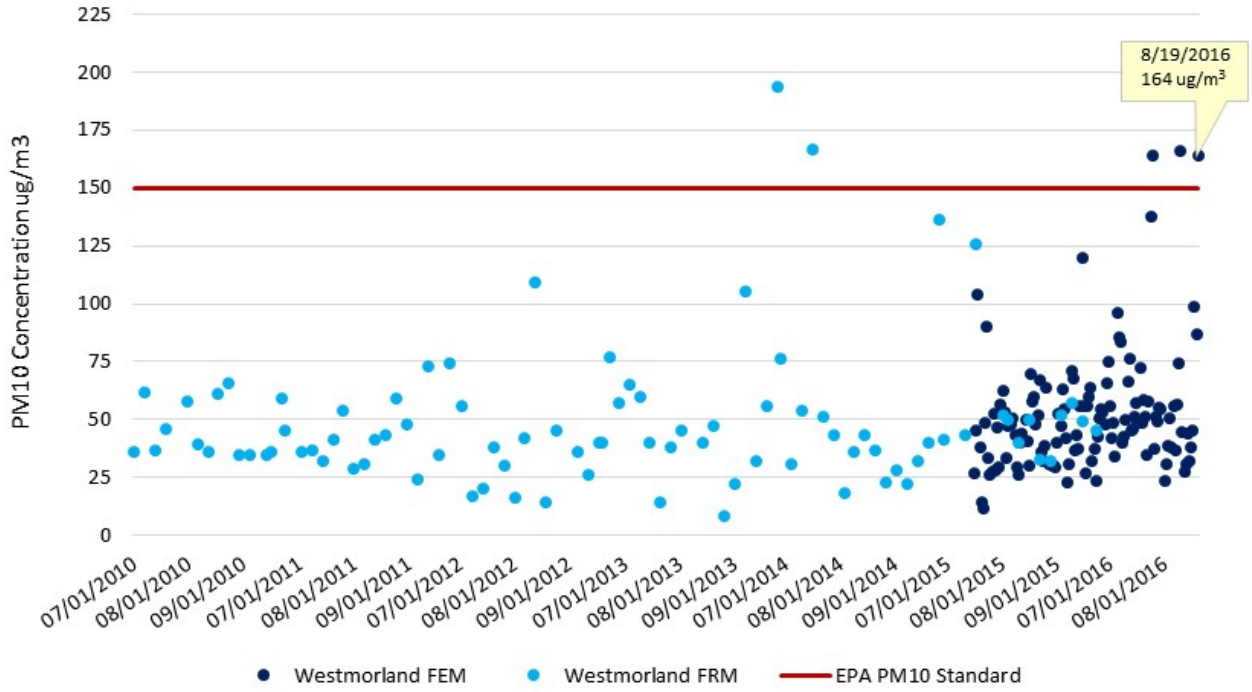
FIGURE 3-4
BRAWLEY SEASONAL COMPARISON
PM_{10} 24-HR AVG CONCENTRATIONS
***JULY 1, 2010 THROUGH AUGUST 19, 2016**



***July 1, 2010 through September 30, 2015 and July 1, 2016 through August 19, 2016**

Fig 3-4: A comparison of PM_{10} historical concentrations demonstrates that the measured concentration of 156 µg/m^3 on August 19, 2016 by the Brawley monitor was outside the normal historical measurements

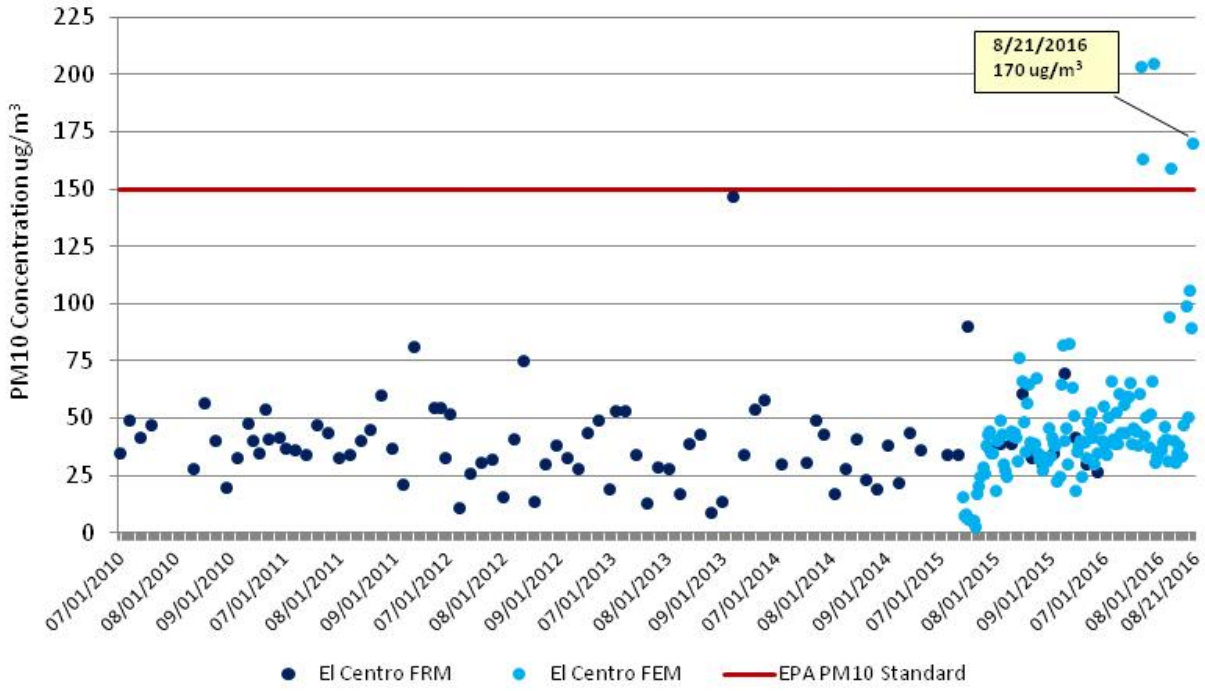
FIGURE 3-5
WESTMORLAND SEASONAL COMPARISON
PM_{10} 24-HR AVG CONCENTRATIONS
***JULY 1, 2010 THROUGH AUGUST 19, 2016**



***July 1, 2010 through September 30, 2015 and July 1, 2016 through August 19, 2016**

Fig 3-5: A comparison of PM_{10} historical concentrations demonstrates that the measured concentrations of 164 µg/m^3 on August 19, 2016 by the Westmorland monitor were outside the normal historical measurements

FIGURE 3-6
EL CENTRO SEASONAL COMPARISON
PM_{10} 24-HR AVG CONCENTRATIONS
***JULY 1, 2010 THROUGH AUGUST 21, 2016**



***July 1, 2010 through September 30, 2015 and July 1, 2016 through August 21, 2016**

Fig 3-6: A comparison of PM_{10} historical concentrations demonstrates that the measured concentration of 170 µg/m^3 on August 21, 2016 on by the El Centro monitor was outside the normal historical measurements

Figures 3-34 through 3-6 display the seasonal fluctuations over 602 sampling days at the Brawley, Westmorland and El Centro stations for months July through September of years 2010 through 2016 (2016 ending August 19, 2016 and August 21, 2016). The seasonal sampling period for Brawley (**Figure 3-3**) contains 697 combined FRM and FEM samples. Of these, 10 exceedances occurred during the third quarter which translates into 1.4% of all samples. The seasonal sampling period for Westmorland station (**Figure 3-4**)[23] contains 217 credible samples and six exceedance days, or 2.8% of all samples.

[23] FEM sampling at the Westmorland site began July 2015 therefore January is the only seasonal first-quarter data available.

FIGURE 3-7
BRAWLEY HISTORICAL
PM_{10} 24 HR FRM & FEM CONCENTRATIONS
JANUARY 2010 THROUGH AUGUST 19, 2016

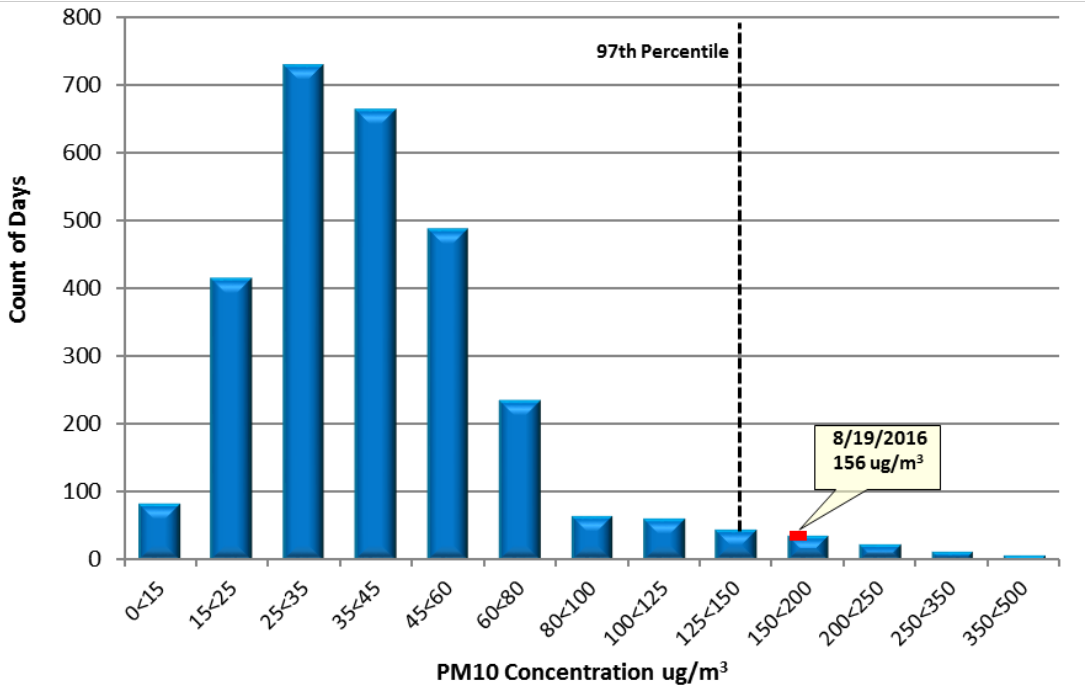


Fig 3-7: The 24-hr average PM_{10} concentration at the Calexico monitoring site demonstrates that the concentration of 156 µg/m^3 on August 19, 2016 was in excess of the 97th percentile

FIGURE 3-8
WESTMORLAND HISTORICAL
PM_{10} 24 HR FRM & FEM CONCENTRATIONS
JANUARY 2010 THROUGH AUGUST 19, 2016

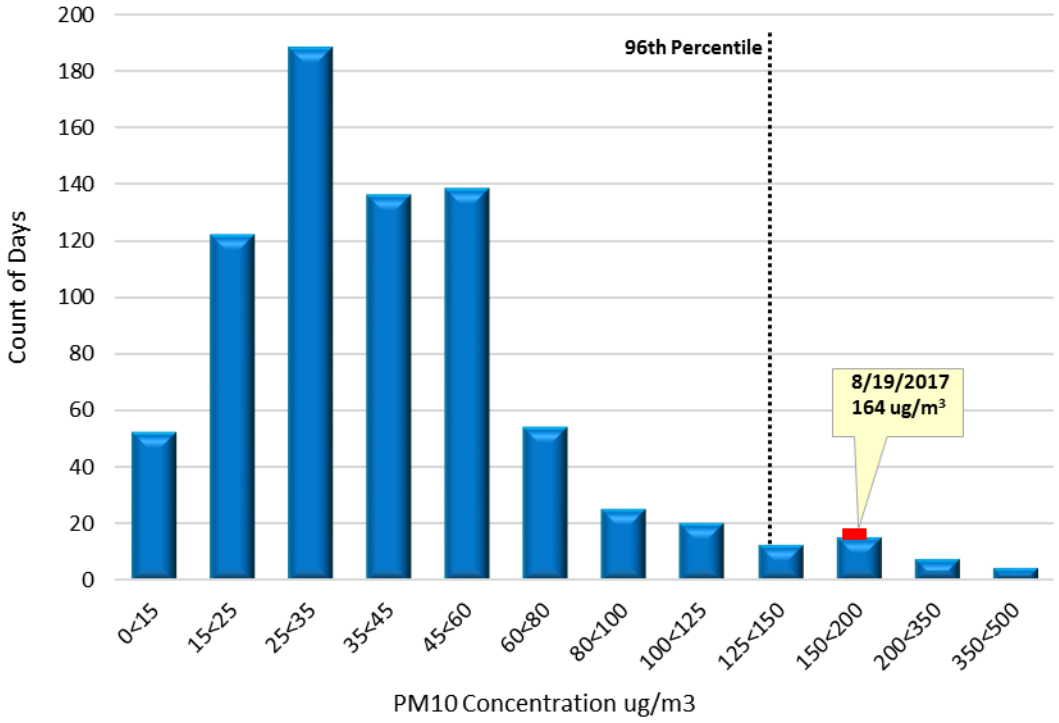


Fig 3-8: The 24-hr average PM_{10} concentration at the Westmorland monitoring site demonstrates that the concentration of 164 µg/m^3 on August 19, 2016 fell on the 96th percentile

FIGURE 3-9
EL CENTRO HISTORICAL
PM_{10} 24 HR FRM & FEM CONCENTRATIONS
JANUARY 2010 THROUGH AUGUST 21, 2016

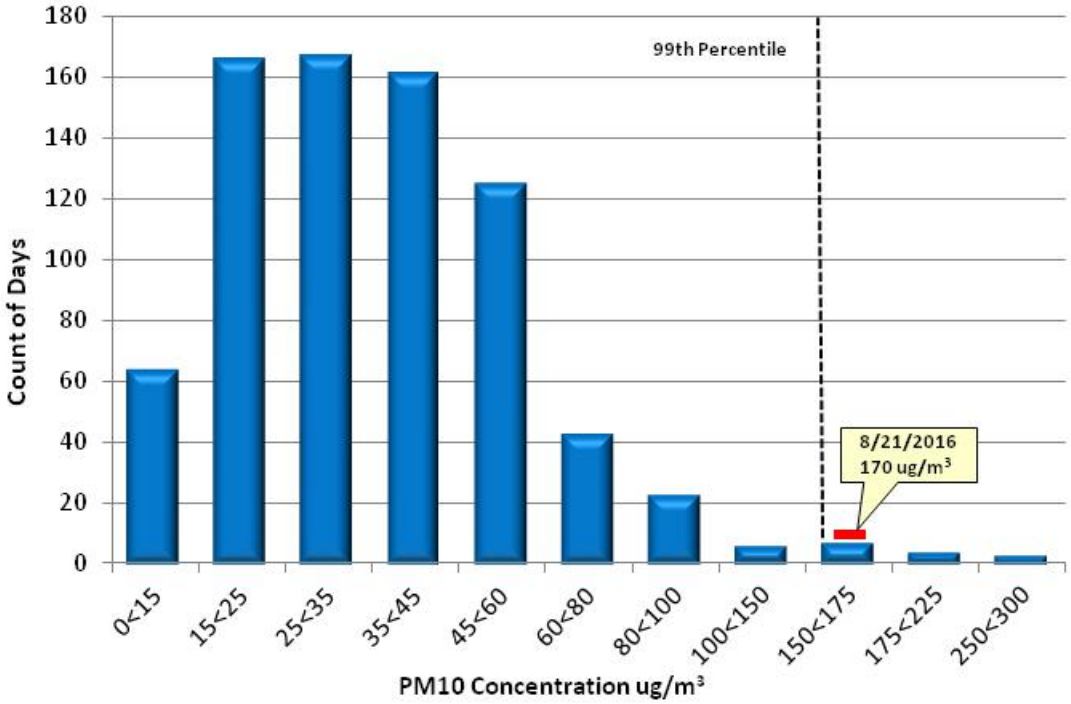


Fig 3-9: The 24-hr average PM_{10} concentration at the Calexico monitoring site demonstrates that the concentration of 170 µg/m^3 on August 21, 2016 was in excess of the 99th percentile.

For the combined FRM and FEM data sets, the annual historical and the seasonal historical PM_{10} concentrations of 156 µg/m^3, 164 µg/m^3 and 170 µg/m^3 ranked at the 97th percentile, the 96th percentile and the 99th percentile for Brawley, Westmorland and El Centro, respectively.

Looking at the annual time series concentrations, the seasonal time series concentrations, and the percentile rankings for both the historical and seasonal patterns, the August 19, 2016 and the August 21, 2016 measured exceedances are clearly outside the normal concentration levels when comparing to non-event days and event days.

III.2 Summary

The information provided, above, by the time series plots, seasonal time series plots, and the percentile rankings illustrate that the PM_{10} concentration observed on August 19, 2016 and August 21, 2016 occurs infrequently. When comparing the measured PM_{10} levels on August 19, 2016 and August 21, 2016 and following USEPA EER guidance, this demonstration provides supporting evidence that the measured exceedances measured at the Brawley, Westmorland and El Centro monitors were outside the normal historical and seasonal historical concentration levels.

The historical concentration analysis provided here supports the determination that the August 19, 2016 and the August 21, 2016 natural event affected the concentrations levels at the Brawley, Westmorland and El Centro monitors causing an exceedance. The concentration analysis further supports that the natural event affected air quality in such a way that there exists a clear causal relationship between the measured exceedances on August 19, 2016 and August 21, 2016 and the natural event, qualifying the natural event as an Exceptional Event.

IV Not Reasonably Controllable or Preventable

According to the October 3, 2016 promulgated revision to the Exceptional Event (EE) rule under 40 CFR §50.14(b)(8) air agencies must address the "not reasonably controllable or preventable" (nRCP) criterion as two prongs. In order to properly address the nRCP criterion the ICAPCD must not only identify the natural and anthropogenic sources of emissions causing and contributing to the monitored exceedance but must identify the relevant State Implementation Plan (SIP) measures and/or other enforceable control measures in place for the identified sources. An effective analysis of the nRCP must include the implementation status of the control measures in order to properly consider the measures as enforceable. USEPA considers control measures to be enforceable if approved into the SIP within 5 years of an EE demonstration submittal. The identified control measures must address those specific sources that are identified as causing or contributing to a monitored exceedance.

The final EE rule revision explains that an event is considered not reasonably controllable if reasonable measures to control the impact of the event on air quality were applied at the time of the event. Similarly, an event is considered not reasonably preventable if reasonable measures to prevent the event were applied at the time of the event. However, for "high wind events" when PM_{10} concentrations are due to dust raised by high winds from desert areas whose sources are controlled with Best Available Control Measures (BACM) then the event is a "natural event" where human activity plays little or no direct causal role and thus is considered not preventable.

This section begins by providing background information on all SIP and other enforceable control measures in force during the EE for August 19, 2016 and August 21, 2016. In addition, this August 19, 2016 and August 21, 2016 demonstration provides technical and non-technical evidence that short-lived, erratic southerly winds blew across the deserts of northern Mexico and Arizona and into Imperial County suspending particulate matter affecting the Brawley, Westmorland and El Centro monitors on August 19, 2016 and August 21, 2016. This section identifies all natural and anthropogenic sources and provides regulatory evidence of the enforceability of the control measures in place during the August 19, 2016 and August 21, 2016 EE.

IV.1 Background

Inhalable particulate matter (PM_{10}) contributes to effects that are harmful to human health and the environment, including premature mortality, aggravation of respiratory and cardiovascular disease, decreased lung function, visibility impairment, and damage to vegetation and ecosystems. Upon enactment of the 1990 Clean Air Act (CAA) amendments, Imperial County was classified as moderate nonattainment for the PM_{10} NAAQS under CAA sections 107(d)(4)(B) and 188(a). By November 15, 1991, such areas were required to develop and submit State Implementation Plan (SIP) revisions providing for, among other things, implementation of reasonably available control measures (RACM).

Partly to address the RACM requirement, ICAPCD adopted local Regulation VIII rules to control PM_{10} from sources of fugitive dust on October 10, 1994, and revised them on November 25, 1996. USEPA did not act on these versions of the rules with respect to the federally enforceable SIP.

On August 11, 2004, USEPA reclassified Imperial County as a serious nonattainment area for PM_{10}. As a result, CAA section 189(b)(1)(B) required all BACM to be implemented in the area within four years of the effective date of the reclassification, i.e., by September 10, 2008.

On November 8, 2005, partly to address the BACM requirement, ICAPCD revised the Regulation VIII rules to strengthen fugitive dust requirements. On July 8, 2010, USEPA finalized a limited approval of the 2005 version of Regulation VIII, finding that the seven Regulation VIII rules largely fulfilled the relevant CAA requirements. Simultaneously, USEPA also finalized a limited disapproval of several of the rules, identifying specific deficiencies that needed to be addressed to fully demonstrate compliance with CAA requirements regarding BACM and enforceability.

In September 2010, ICAPCD and the California Department of Parks and Recreation (DPR) filed petitions with the Ninth Circuit Federal Court of Appeals for review of USEPA's limited disapproval of the rules. After hearing oral argument on February 15, 2012, the Ninth Circuit directed the parties to consider mediation before rendering a decision on the litigation. On July 27, 2012, ICAPCD, DPR and USEPA reached agreement on a resolution to the dispute which included a set of specific revisions to Regulation VIII. These revisions are reflected in the version of Regulation VIII adopted by ICAPCD on October 16, 2012 and approved by USEPA April 22, 2013. Since 2006 ICAPCD had implemented regulatory measures to control emissions from fugitive dust sources and open burning in Imperial County.

FIGURE 4-1
REGULATION VIII GRAPHIC TIMELINE DEVELOPMENT

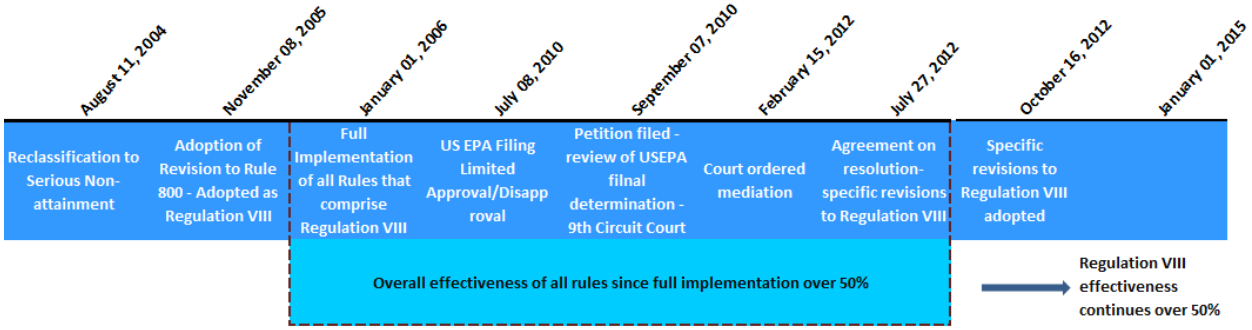


Fig 4-1: Regulation VIII Graphic Timeline

IV.1.a Control Measures

Below is a brief summary of Regulation VIII, which is comprised of seven fugitive dust rules. **Appendix D** contains a complete set of the Regulation VIII rules.

ICAPCD's Regulation VIII consists of seven interrelated rules designed to limit emissions of PM_{10} from anthropogenic fugitive dust sources in Imperial County.

Rule 800, General Requirements for Control of Fine Particulate Matter, provides definitions, a compliance schedule, exemptions and other requirements generally applicable to all seven rules. It requires the United States Bureau of Land Management (BLM), United States Border Patrol (BP) and DPR to submit dust control plans (DCP) to mitigate fugitive dust from areas and/or activities under their control. Appendices A and B within Rule 800 describe methods for determining compliance with opacity and surface stabilization requirements in Rules 801 through 806.

Rule 801, Construction and Earthmoving Activities, establishes a 20% opacity limit and control requirements for construction and earthmoving activities. Affected sources must submit a DCP and comply with other portions of Regulation VIII regarding bulk materials, carry-out and track-out, and paved and unpaved roads. The rule exempts single family homes and waives the 20% opacity limit in winds over 25 mph under certain conditions.

Rule 802, Bulk Materials, establishes a 20% opacity limit and other requirements to control dust from bulk material handling, storage, transport and hauling.

Rule 803, Carry-Out and Track-Out, establishes requirements to prevent and clean-up mud and dirt transported onto paved roads from unpaved roads and areas.

Rule 804, Open Areas, establishes a 20% opacity limit and requires land owners to prevent vehicular trespass and stabilize disturbed soil on open areas larger than 0.5 acres in urban areas, and larger than three acres in rural areas. Agricultural operations are exempted.

Rule 805, Paved and Unpaved Roads, establishes a 20% opacity limit and control requirements for unpaved haul and access roads, canal roads and traffic areas that meet certain size or traffic thresholds. It also prohibits construction of new unpaved roads in certain circumstances. Single-family residences and agricultural operations are exempted.

Rule 806, Conservation Management Practices, requires agricultural operation sites greater than 40 acres to implement at least one conservation management practice (CMP) for each of several activities that often generates dust at agricultural operations. In addition, agricultural operation sites must prepare a CMP plan describing how they comply with Rule 806, and must make the CMP plan available to the ICAPCD upon request.

IV.1.b Additional Measures

Imperial County Natural Events Action Plan (NEAP)

On August 2005, the ICAPCD adopted a NEAP for the Imperial County, as was required under the former USEPA Natural Events Policy, to address PM_{10} events by:

- Protecting public health;
- Educating the public about high wind events;
- Mitigating health impacts on the community during future events; and
- Identifying and implementing BACM measures for anthropogenic sources of windblown dust.

Smoke Management Plan (SMP) Summary

There are 35 Air Pollution Control Districts or Air Quality Management Districts in California which are required to implement a district-wide smoke management program. The regulatory basis for California's Smoke Management Program, codified under Title 17 of the California Code of Regulations is the "Smoke Management Guidelines for Agricultural and Prescribed Burning" (Guidelines). California's 1987 Guidelines were revised to improve interagency coordination, avoid smoke episodes, and provide continued public safety while providing adequate opportunity for necessary open burning. The revisions to the 1987 Guidelines were approved March 14, 2001. All air districts, with the exception of the San Joaquin Valley Air Pollution Control District (SJAPCD) were required to update their existing rules and Smoke Management Plans to conform to the most recent update to the Guidelines.

Section 80150 of Title 17 specifies the special requirements for open burning in agricultural operations, the growing of crops and the raising of fowl or animals. This section specifically requires the ICAPCD to have rules and regulations that require permits that contain requirements that minimize smoke impacts from agricultural burning.

On a daily basis, the ICAPCD reviews surface meteorological reports from various airport agencies, the NWS, State fire agencies and CARB to help determine whether the day is a burn day. Using a four quadrant map of Imperial County allowed burns are allocated in such a manner as to assure minimal to no smoke impacts safeguarding the public health. Finally, the Good Neighbor Policy requires all permit holders to provide notice and advise members of the public of a potential burn. On August 19, 2016 the ICAPCD issued a "Marginal Green Waste Only" burn day while on August 21, 2016 the ICAPCD issued a "NO" burn day **(Appendix A).** No agricultural burn complaints were filed August 19, 2016 or August 21, 2016.

IV.1.c Review of Source Permitted Inspections and Public Complaints

The ICAPCD compiled and reviewed a query of the permit database for active permitted sources throughout Imperial County and specifically around Brawley, Westmorland and El Centro during the August 19, 2016 and August 21, 2016 PM_{10} exceedance. Both permitted and non-permitted sources are required to comply with Regulation VIII requirements that address fugitive dust emissions. The identified permitted sources are Aggregate Products, Inc., US Gypsum Quarry, Imperial Aggregates (Val-Rock, Inc., and Granite Construction), US Gypsum Plaster City, Clean Harbors (Laidlaw Environmental Services), Bullfrog Farms (Dairy), Burrtec Waste Industries, Border Patrol Inspection station, Centinela State Prison, various communications towers not

listed and various agricultural operations. Non-permitted sources include the wind farm known as Ocotillo Express, and a solar facility known as CSolar IV West. Finally, the desert regions, including the Anza Borrego State Park, Ocotillo Wells are under the jurisdiction of the Bureau of Land Management and the California Department of Parks.

An evaluation of all inspection reports, air quality complaints, compliance reports, and other documentation indicate no evidence of unusual anthropogenic-based PM_{10} emissions. For either day, August 19, 2016 (officially a "Marginal Green Waste Only" burn day) and August 21, 2016 (officially a "NO" burn day) no agricultural or waste burning or dust complaints were received.

FIGURE 4-2
PERMITTED SOURCES

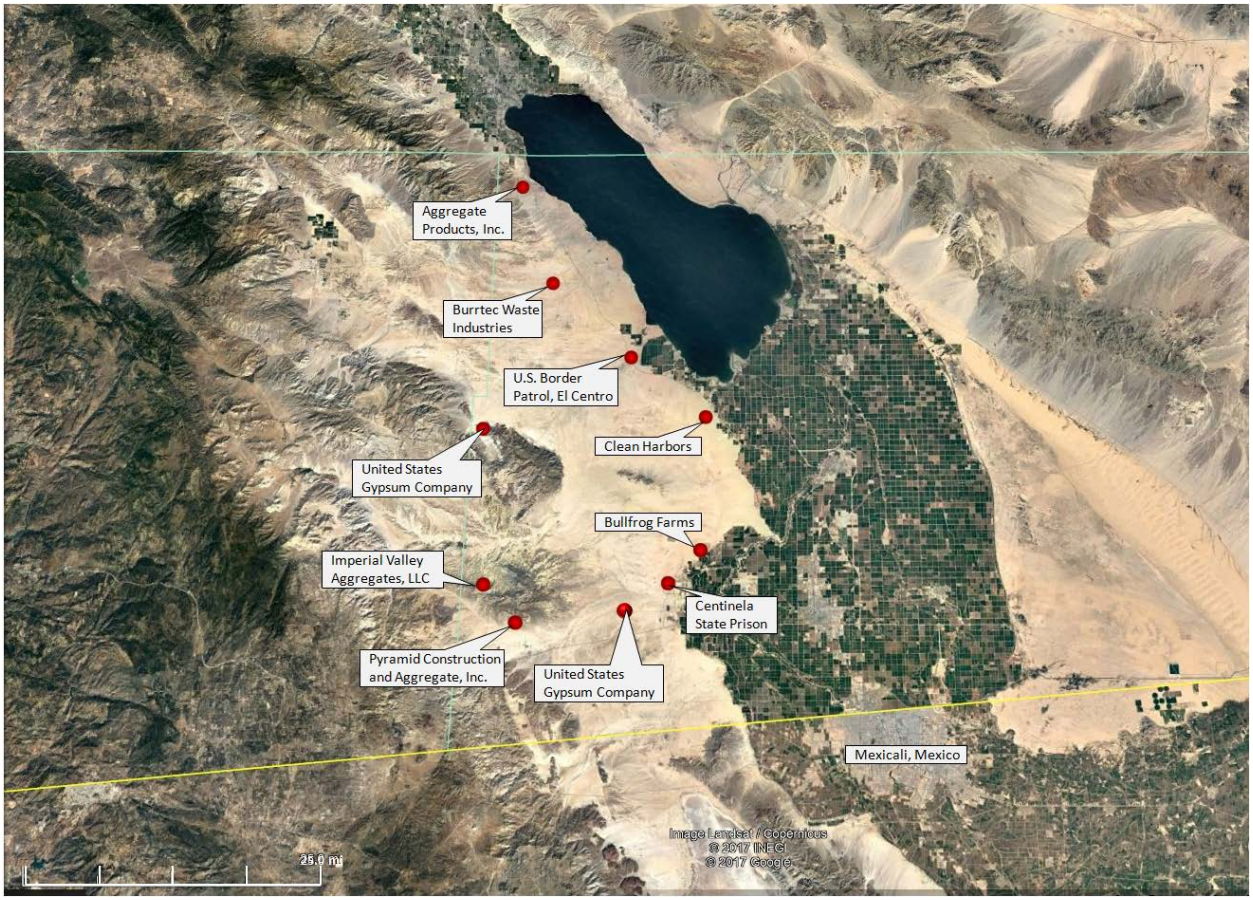


Fig 4-2: The above map identifies those permitted sources located west, northwest and southwest of the air monitors in Imperial County. The green line to the north denotes the political division between Imperial and Riverside counties. The yellow line below denotes the international border between the United States and Mexico. The green checker-boarded areas are a mixed use of agricultural and community parcels. In addition, the desert areas are managed either by the Bureau of Land Management or the California Department of Parks. Base map from Google Earth.

FIGURE 4-3
NON-PERMITTED SOURCES

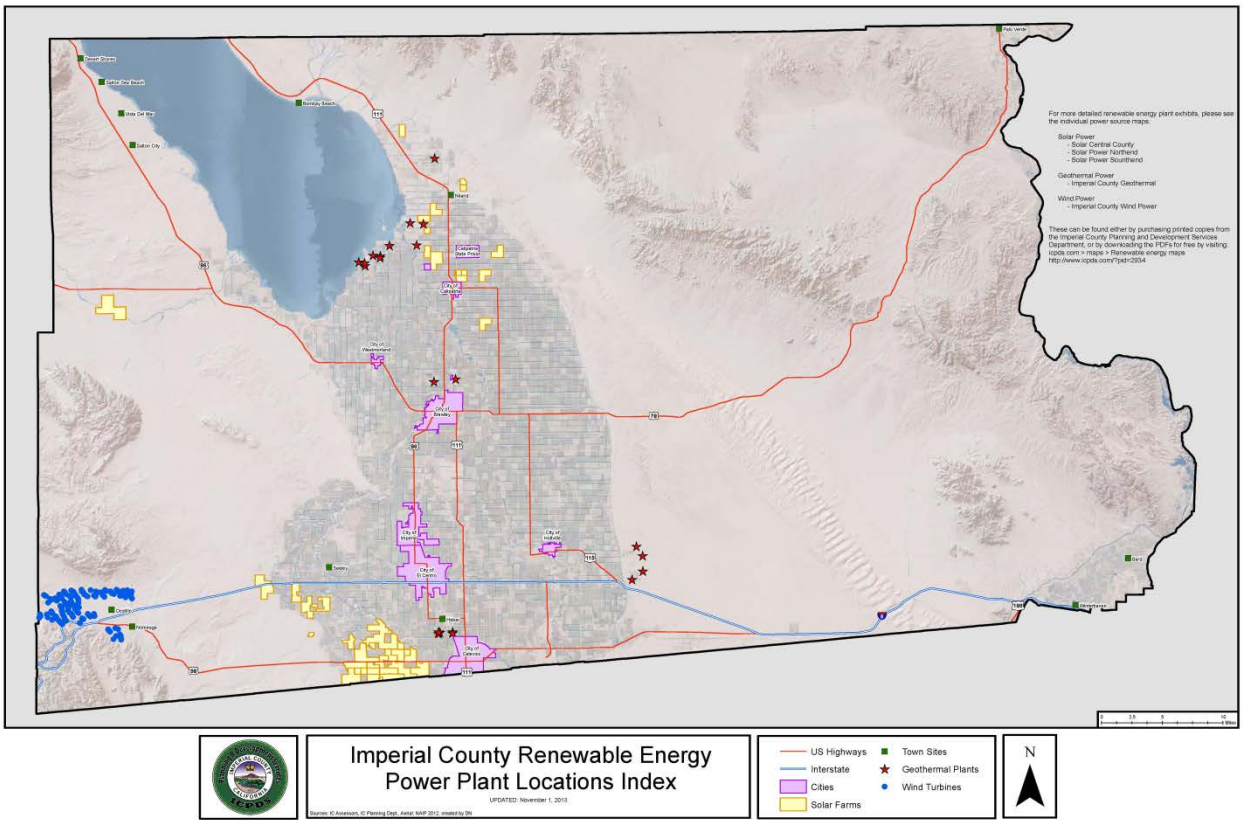


Fig 4-3: The above map identifies those power sources located west, northwest and southwest of the air monitors in Imperial County. Blue indicate the Wind Turbines, Yellow are the solar farms and stars are geothermal plants.

IV.2 Forecasts and Warnings

As discussed earlier, the ICAPCD published the National Weather Service (NWS) forecast for August 19, 2016 through August 22, 2016. The published notification, via the ICAPCD's webpage, forecast included the description of a weak low-pressure system off the Southern California coast as causing a slight cooling through early next week. Although confidence of regional thunderstorms was not high, the NWS opted to include the potential of thunderstorm activity in California and Arizona. Thus the forecast description included the presence of residual mid-level monsoonal moisture that would allow for a slight chance of afternoon and early evening thunderstorms along the San Bernardino, Riverside Mountains and the San Diego Mountains and deserts. The accompanying San Diego NWS weather story issued for August 19, 2016 identified the location, timing and impacts of the potential afternoon and evening thunderstorms. The identified threats from the storms included gusty winds, patchy blowing dust, lightening, small hail and very isolated rainfall. The forecast indicated that the weather system would pass through the middle of the coming week indicating an effect upon the region for days.

In all, the Phoenix NWS office issued no less than 120 public notices such as Urgent Weather Messages, Special Weather Statements, Bulletins, Severe Weather Statements, Flash Flood Statements, Flood Advisories, Public Information Statements, Preliminary Local Storm Reports, and Flood Statements. The San Diego NWS office by contrast issued six pubic notices, such as Hydrologic Forecast Flash Flood Potential, Urgent Weather Message for heat, and Flood Advisories. **Figure 4-4** is a replica of **Figure 2-28** and identifies some of the local areas mentioned within the issued notices by either the Phoenix or San Diego NWS.

FIGURE 4-4
AREAS IDENTIFIED BY THE NWS AFFECTED BY THUNDERSTORMS ON AUGUST 19, 2016 AND AUGUST 21, 2016

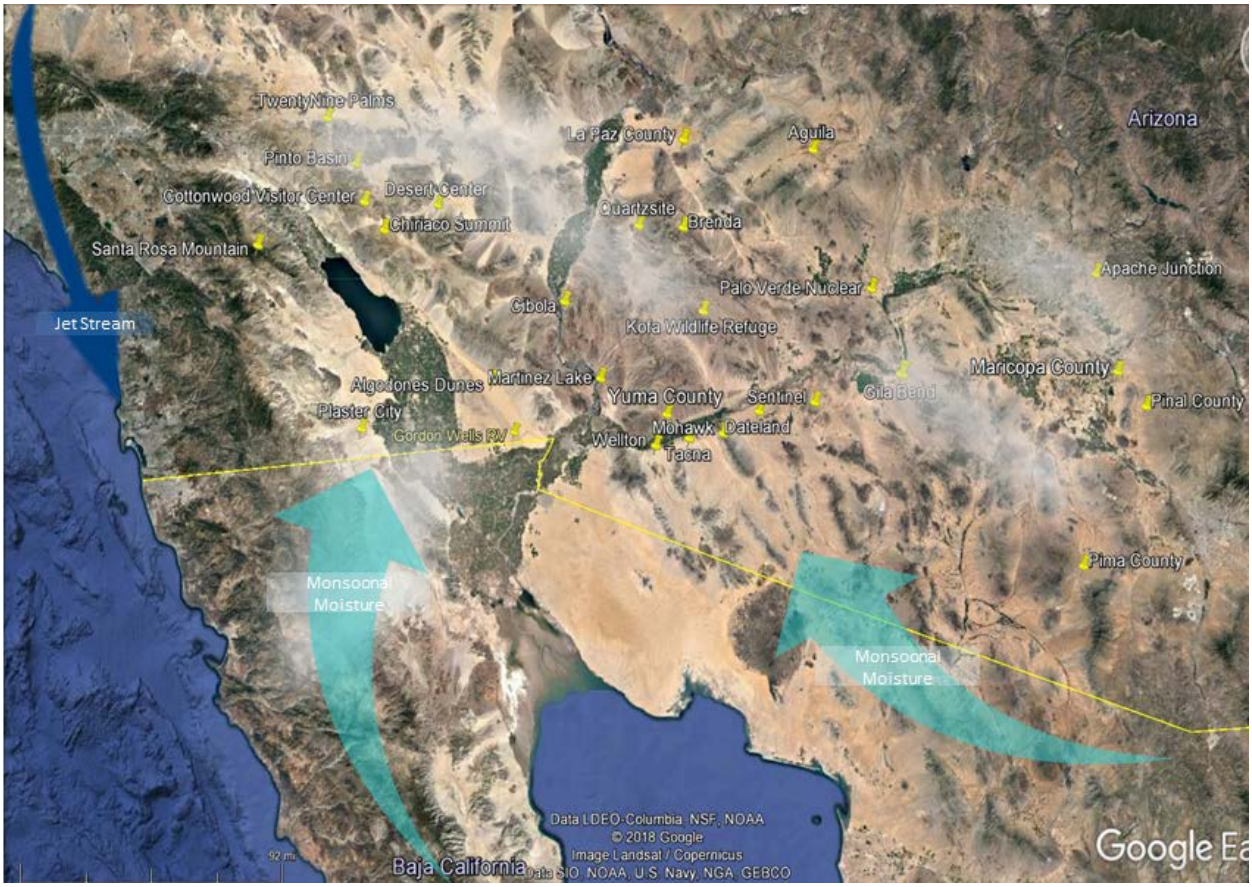


Fig 4-4: The National Weather Service issued no less than 126 notices as either Flood Advisories, Flood Warnings, Urgent Weather Messages, Special Weather Statements, Bulletins, Preliminary Storm reports, and Severe Weather Statements that identified areas affected by thunderstorm activity on August 19, 2016 and August 21, 2016. Source: Phoenix and San Diego NWS offices

IV.3 Wind Observations

Wind data during the event were available from airports in eastern Riverside County, southeastern San Diego County, southwestern Yuma County (Arizona), northern Mexico, and Imperial County (**Table 2-2**). Data were also collected from automated meteorological instruments that were upstream from the Brawley and Westmorland monitors during the wind event. On August 18, 2016, the Blythe Airport (KBLH), measured winds above 25 mph (NE) located upstream from Imperial County. On August 19, 2016, the Imperial County Airport (KIPL) and the El Centro NAF (KNJK) both measured winds at or above 25 mph for at least one hour. Gusts reached 40 mph at KNJK. On August 21, 2016, the Yuma MCAS (KNYL) measured winds of 22 mph for at least one hour. Airport observations included blowing dust the hour prior to the measured hourly peak concentration at the El Centro monitor August 21, 2016. Wind speeds of 25 mph are normally sufficient to overcome most PM_{10} control measures. During the August 19, 2016 and August 21, 2016 event, wind speeds were at or above the 25 mph threshold, overcoming the BACM in place.

IV.4 Summary

The weather and air quality forecasts and warnings outlined in this section demonstrate that windblown dust from short-lived and isolated thunderstorm outflow boundaries travelled from Arizona and northern Mexico into Imperial County causing uncontrollable PM_{10} emissions. The BACM list as part of the control measures in Imperial County for fugitive dust emissions were in place at the time of the event. These control measures are required for areas designated as "serious" non-attainment for PM_{10}, such as Imperial County. Thus, the BACM in place at the time of the event were beyond reasonable. In addition, surface wind measurements at or upstream of the Brawley, Westmorland and El Centro monitoring stations during the event were high enough (at or above 25 mph) that BACM PM_{10} control measures would have been overwhelmed.

Finally, a high wind dust event can be considered as a natural event, even when portions of the wind-driven emissions are anthropogenic, as long as those emissions have a clear causal relationship to the event and were determined to be not reasonably controllable or preventable. This demonstration has shown that the event that occurred on August 19, 2016 and August 21, 2016 was not reasonably controllable or preventable despite the strong and in force BACM within the affected areas in Imperial County. This demonstration has similarly established a clear causal relationship between the exceedances and the wind event timeline and geographic location. The August 19, 2016 and August 21, 2016 event can be considered an exceptional event under the requirements of the exceptional event rule.

V Clear Causal Relationship

V.1 Discussion

Meteorological observations for August 19, 2016 and August 21, 2016 identified a weather pattern that was not usual for August. A large upper level trough, described as a weak and nearly stationary closed low, formed and moved just off Point Conception where it remained through August 22, 2016. As early as Tuesday, August 16, 2016 the trough formed and began is very slow descent down the California allowing for cooling conditions but not enough to displace the Pacific ridge over Southern California. By August 19, 2016, the closed low established itself off Point Conception where it remained through August 22, 2016 allowing moisture to enter and remain within the region. These meteorological conditions allowed a series of shortwaves reinforced by the jet stream to create short-lived and isolated thunderstorm activity that produced substantive outflow boundaries that reached the San Diego County Mountains and deserts and Imperial County.

On August 19, 2016, a weak and nearly stationary closed low, off Point Conception, created a low-level flow from the west, which combined, with a mid-level flow from the south-southeast, allowing moisture to remain resulting in scattered thunderstorms along the San Diego and Imperial County line.[24] These thunderstorms, while short-lived produced local rainfall near 1 inch, along with gusty winds and patchy blowing dust affecting air quality and causing an exceedance at the Brawley and Westmorland monitors on August 19, 2016.

On August 20, 2016, despite the presence of residual moisture within the San Diego Mountains and deserts a weak instability kept thunderstorm activity within central and southeastern Arizona and away from the San Diego Mountains. Essentially, a weak steering flow aloft which favored a westerly direction kept storms along the higher terrain in eastern Arizona during the day.[25] However, as storms developed quickly over the Mogollon rim and the mountains within southeastern Arizona during the afternoon hours, outflow boundaries from these storms moved west and merged with new storms pushing west into the western/southwestern deserts overnight affecting Imperial County on August 21, 2016. Early morning elevated concentrations measured at the air monitors reflect the residual suspended particulates from the previous evening's thunderstorm activities. The brief calm, despite the presence of residual moisture allowed for the settling of particulates before renewed thunderstorm activity during the late evening hours of August 20, 2016.

On August 21, 2016, the continued closed low remaining nearly stationary off Point Conception and the unstable air mass over Yuma County, allowed moisture to remain within the desert southwest providing the ideal meteorological conditions that allowed outflow from thunderstorms over southern Arizona to reach the California desert southwest after 1:00am.[26]

[24] Area Forecast Discussion, National Weather Service San Diego CA, 828 PM PST (928 PM PDT) Friday, August 19, 2016.
[25] Area Forecast Discussion, National Weather Service Phoenix AZ, 100 PM PST (200 PM MST) Saturday, August 20, 2016
[26] Area Forecast Discussion, National Weather Service San Diego CA, 227 AM PST (327 AM PDT) and Phoenix AZ, 745 PM PST (845 PM MST) Sunday, August 21, 2016.

These outflows brought about a few sprinkles, mainly along the Riverside and San Bernardino Mountains and erratic gusty winds with blowing dust affecting air quality and causing an exceedance at the El Centro monitor on August 21, 2016.[27]

Entrained windblown dust from natural areas, particularly from the natural open desert areas south, east and west of Imperial County, along with anthropogenic sources controlled with BACM, is confirmed by the meteorological and air quality observations on August 19, 2016 and August 21, 2016.

Figures 5-1 through 5-10 provide information regarding the expected thunderstorm activity, a brief description of the possible blowing dust, lightning, hail, rain and wind for August 18, 2016 through August 21, 2016. **Figure 5-8 and 5-9** provide NEXRAD information and identify a storm cell east of El Centro, which correlates with the Area Forecast discussion issued by the Phoenix office identifying an impressive storm just south of Yuma on August 21, 2016.

[27] Area Forecast Discussion, National Weather Service Phoenix AZ, 1256 PM PST (156 PM MST) and San Diego CA, 754 AM PST (854 AM PDT), 1211 PM PST (111 PM PDT), Sunday, August 21, 2016.

FIGURE 5-1
PHOENIX NWS WEATHER STORY FOR AUGUST 18, 2016

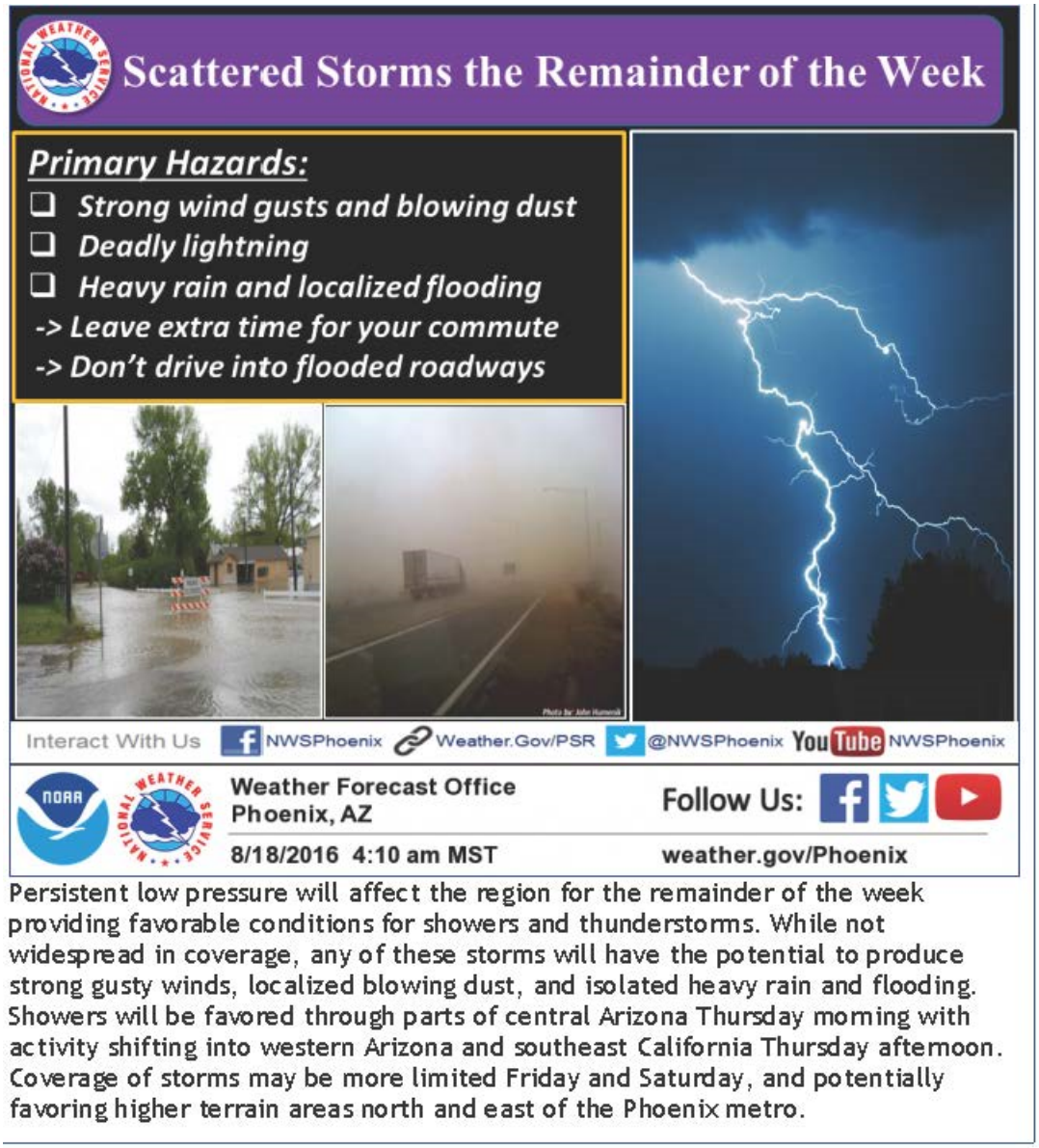


Fig 5-1: The Weather Story issued by the Phoenix NWS office identifies the "persistent" low pressure and the favorable conditions for showers and thunderstorms. Source: National Weather Service Phoenix Office

FIGURE 5-2
WINDS AT BLYTHE ON AUGUST 18, 2016

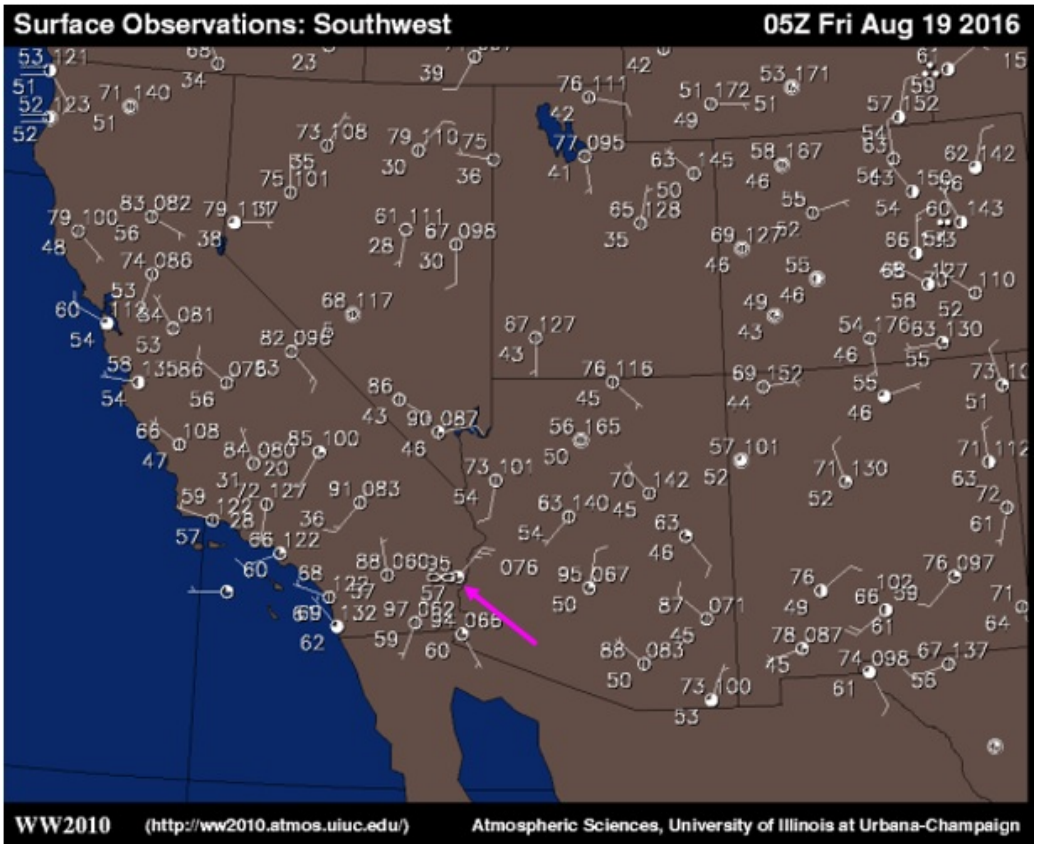


Fig 5-2: A surface wind map with wind barbs depicts northeast winds of at least 28.8 mph at the Blythe Airport during the evening hours of August 18, 2016. As moisture intruded Southern California, developed thunderstorm activity and associated winds affected the San Diego/Imperial County region including those areas north of Imperial County such as Blythe. Actual winds were much higher. Source: University of Illinois Urbana-Champaign; http://ww2010.atmos.uiuc.edu/(Gh)/wx/surface.rxml

FIGURE 5-3
SAN DIEGO NWS WEATHER STORY FOR AUGUST 19, 2016

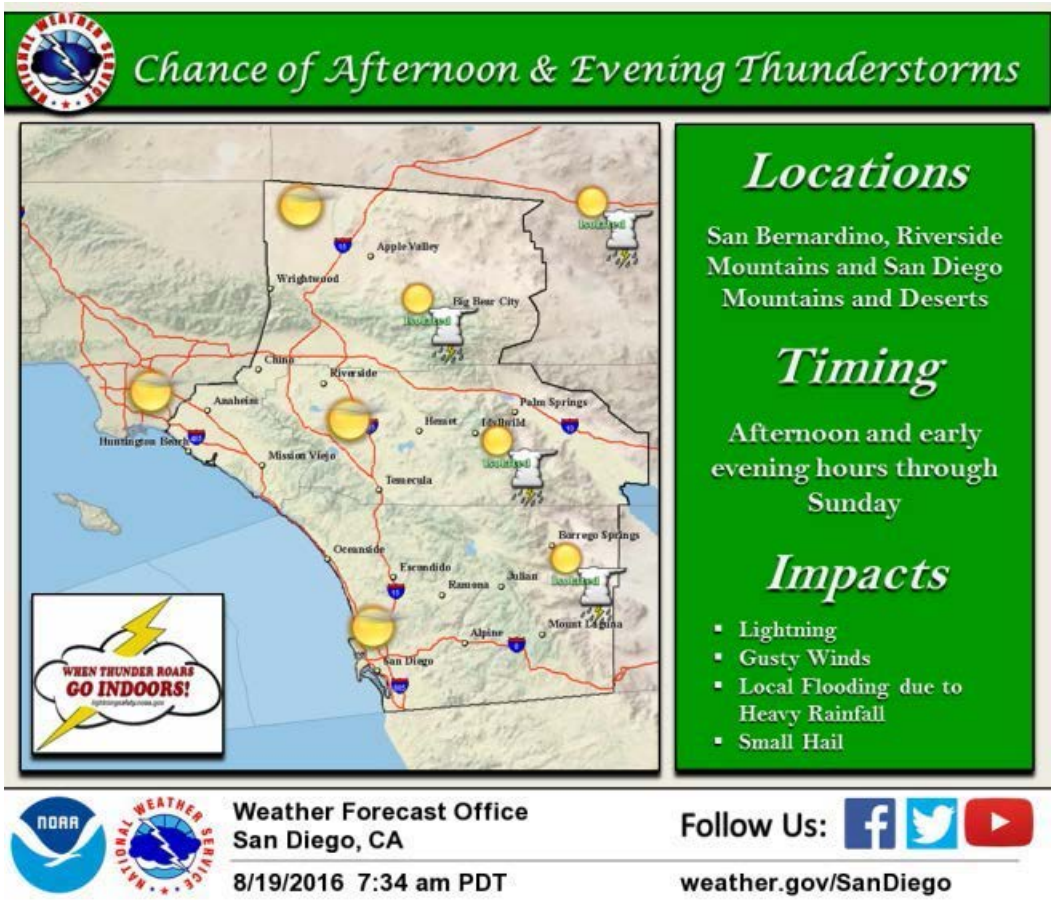


Fig 5-3: The Weather Story for the San Diego NWS office released August 19, 2016 identifies the potential for afternoon and evening thunderstorms and associated gusty winds. Source: San Diego National Weather Service

FIGURE 5-4
SOUTHERLY WINDS IN IMPERIAL COUNTY AUGUST 19, 2016

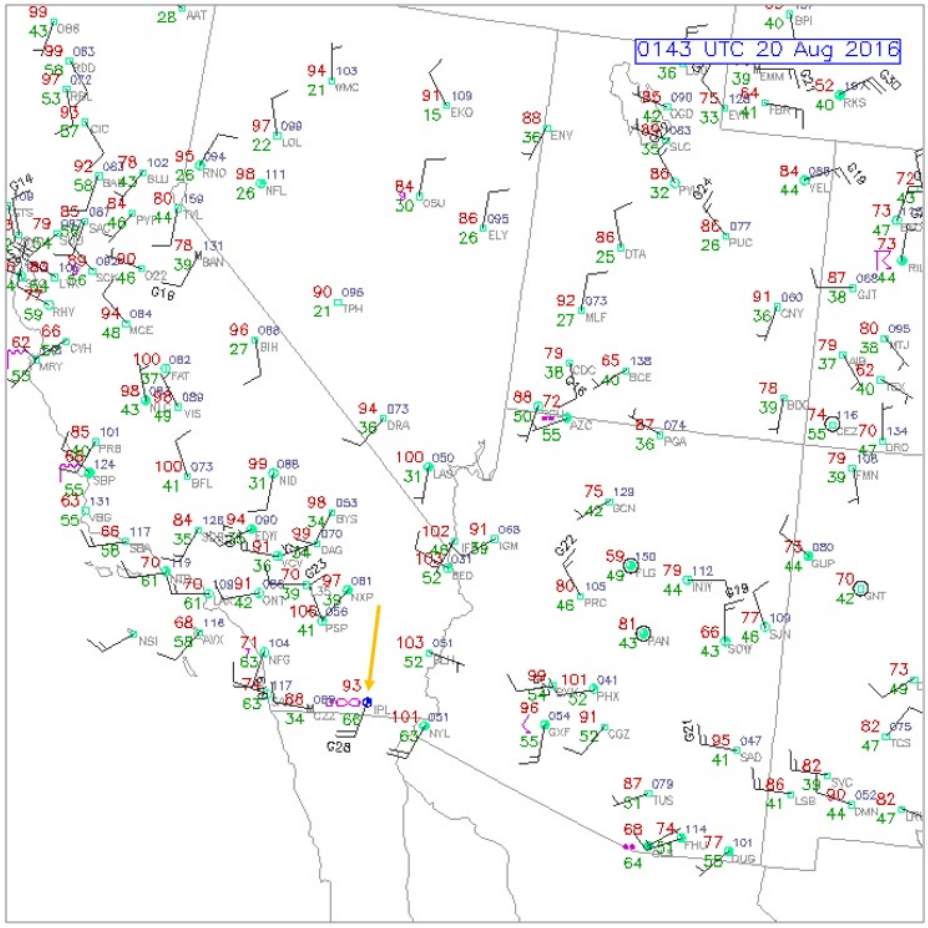


Fig 5-4: A METAR surface wind map, captured at 1743 PST on August 19, 2016, coincident with hourly peak concentrations, depicts southerly winds approaching 25 mph at KIPL along with the symbol for haze. Short-lived gusty winds were above the 25 mph threshold on August 19, 2016. Source: http://weather.rap.ucar.edu/satellite

FIGURE 5-5
DUST STORM WARNING ISSUED FOR IMPERIAL COUNTY

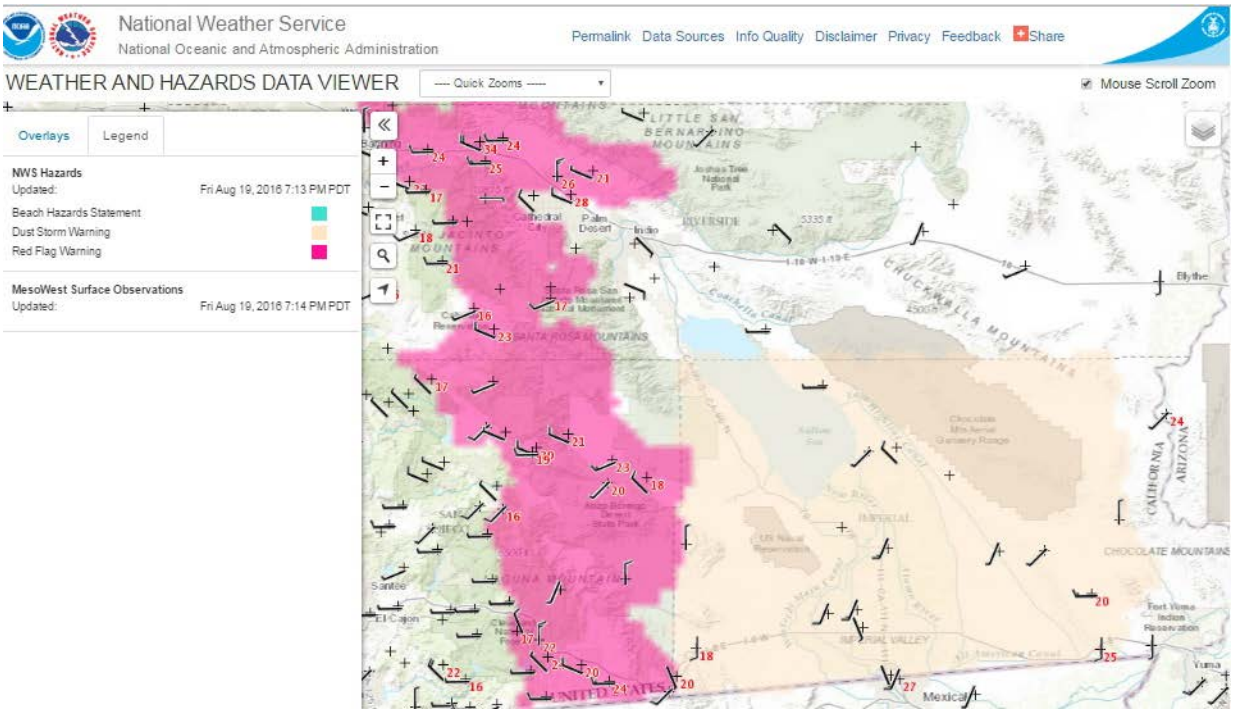


Fig 5-5: The sandy tan color around most of Imperial County signifies the potential for thunderstorm activity for August 19, 2016. Source: Weather and Hazards Data Viewer maintained by the National Weather Service

FIGURE 5-6
PHOENIX NWS WEATHER STORY FOR AUGUST 20, 2016

Fig 5-6: The Weather Story issued by the Phoenix office August 20, 2016 provides information of the continuing effect of the relatively stationary low off the California coast and the potential for continued thunderstorm activity. Although the developed thunderstorms during the evening hours of August 19, 2016 were short-lived enough suspended particulates affected air monitors the morning of August 20, 2016. Meteorological conditions that allowed for the development of the short-lived thunderstorms remained present through the day on August 20, 2016. However, as explained in previous discussions a weak instability kept thunderstorm activity along the Mogollon Rim during the day. By late evening hours of August 20, 2016, outflow boundary winds reached the Colorado River Valley affecting Imperial County air monitors and air quality. Source: National Weather Service Phoenix office

FIGURE 5-7
LIVEHAIL REPORTS AROUND THE YUMA AREA AUGUST 20, 2016

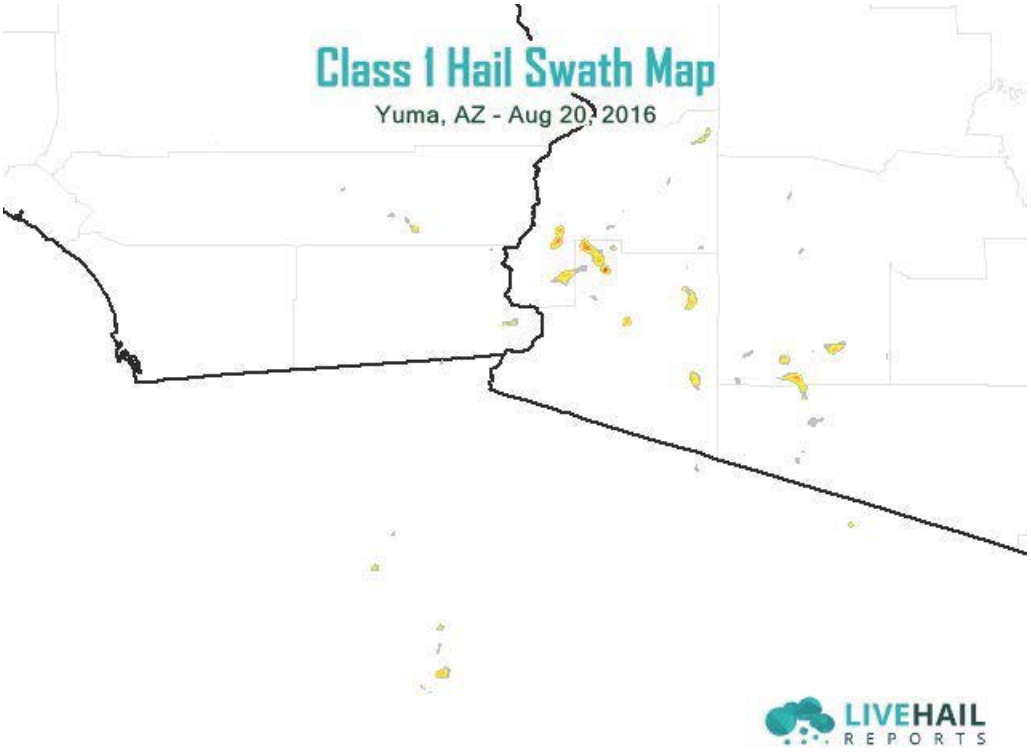


Fig 5-7: LiveHail reports available for sale regarding the Class 1 hail damage reported around Yuma Arizona. These reports provide some indication of the amount of moisture deposited by the thunderstorm activity in Yuma County. While it is unclear the timing of the actual damage at the writing of this demonstration, the point is that thunderstorm activity occurred to the east of Imperial County. NWS discussions described the movement of the outflow boundary from these storms as moving west towards California. Because of the weak instability within the San Diego Mountains, outflows did not reach far west but reached areas in Riverside and Imperial County. Source: LiveHail reports https://livehailreports.com/maps/hail-swath-map-for-yuma-az-on-aug-20-2016/

FIGURE 5-8
NEXRAD BASE REFLECTIVITY IMAGE CAPTURED STRENGTH OF WEATHER SYSTEM

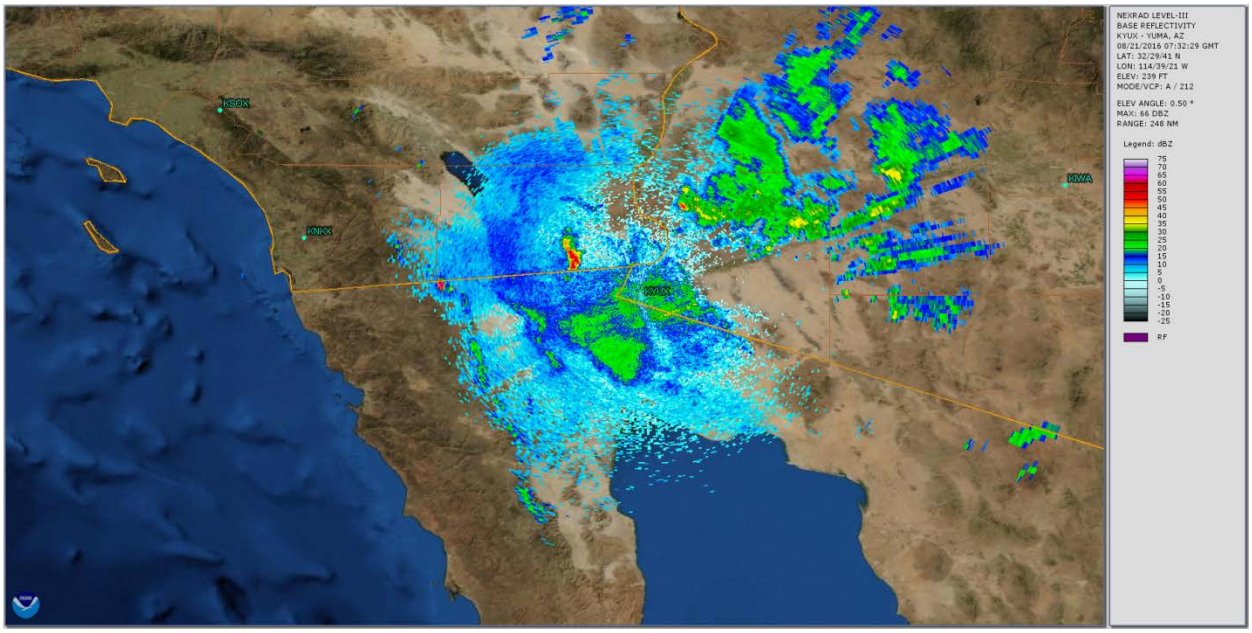


Fig 5-8: A base reflectivity image captured at 2332 PST August 20, 2016 coincident with the hour of elevated gusty winds (KIPL) and measured PM_{10} concentrations. The image is captured by the Yuma KYUX station illustrates the storm cell slightly east of El Centro. Dynamically generated through the NOAA Weather and Climate Toolkit

FIGURE 5-9
NEXRAD BASE VELOCITY IMAGE CAPTURES WINDS ACROSS SOUTHEASTERN CALIFORNIA

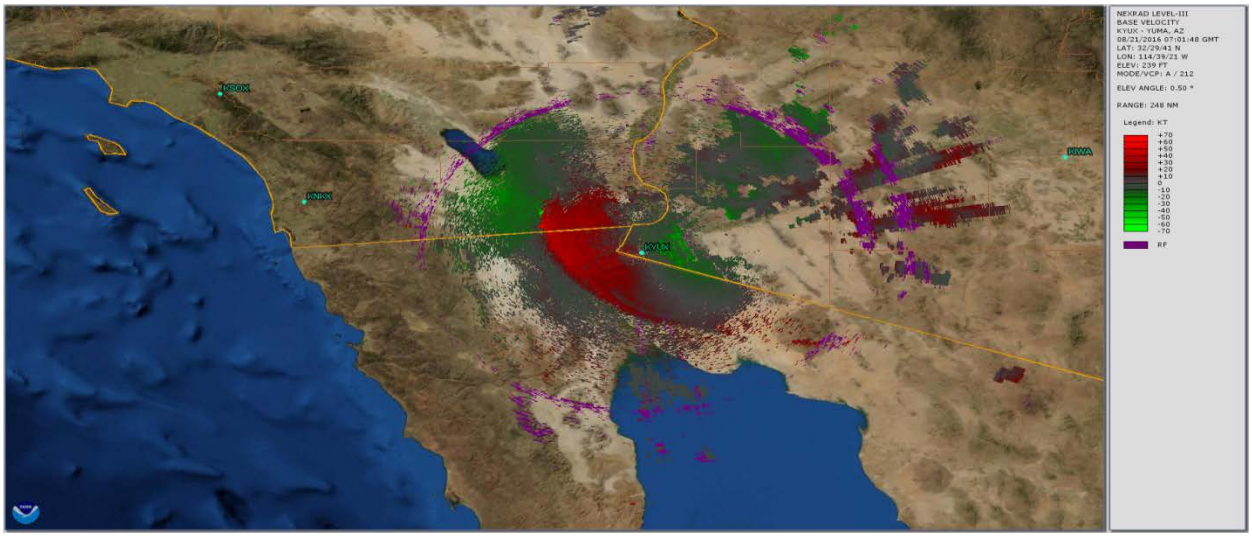


Fig 5-9: A NEXRAD base velocity image captured at 2301 PST August 20, 2016 by the Yuma KYUX station illustrates the general velocity of the winds created by the unstable air mass above Yuma, which is consistent with Area Forecast discussion by the Phoenix office. Green colors indicate motion towards the radar while red colors indicate motion away from the radar. Source: http://weather.rap.ucar.edu/satellite

FIGURE 5-10
SURFACE OBSERVATION MAP WINDS AUGUST 21, 2016

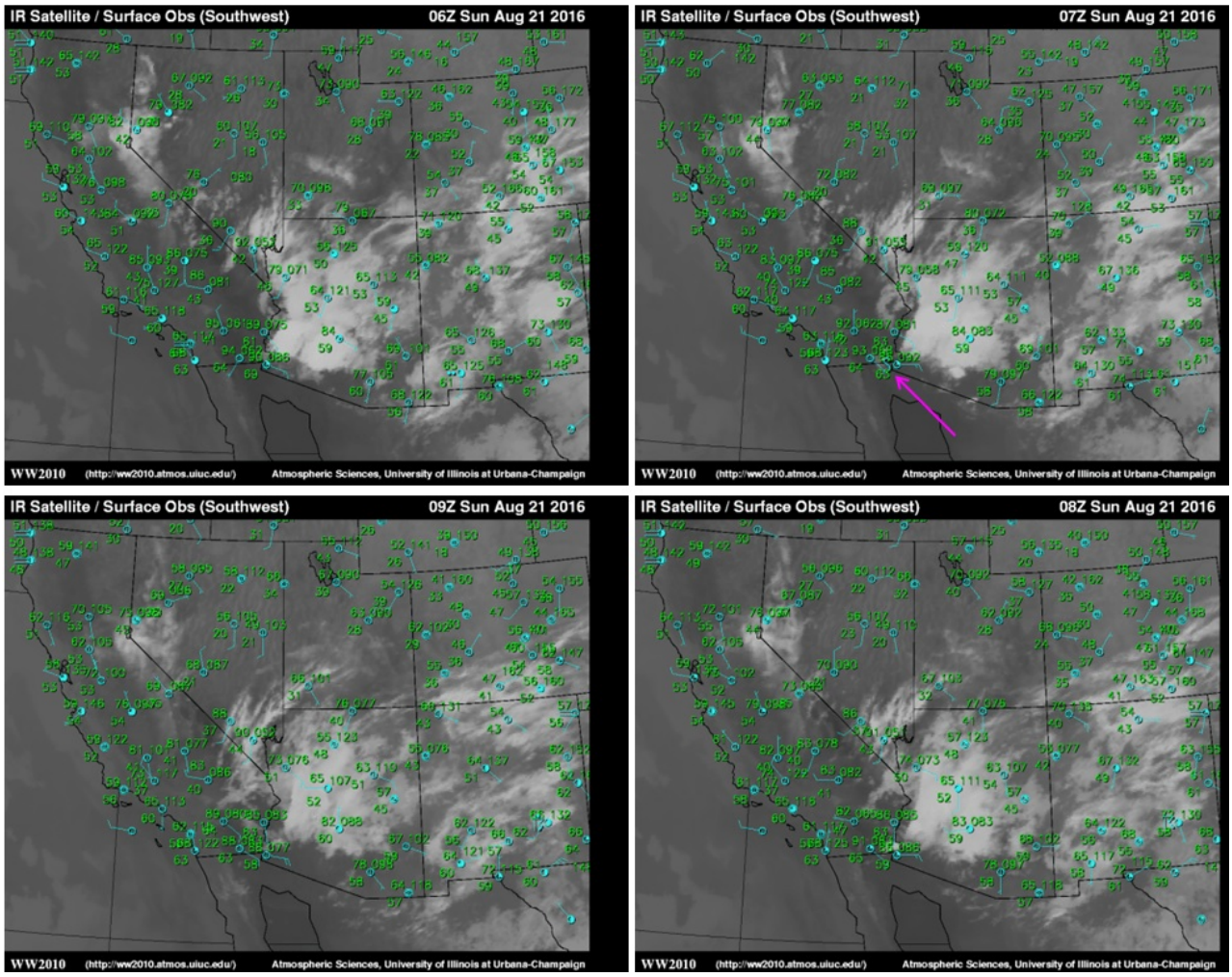


Fig 5-10: A quad of infrared Surface Observation images depicting wind directions and symbols for raised dust in upstream areas from Imperial County. Clockwise from top left: 2200; 2300 (August 20); 0000; 0100 PST August 21. Source: Image/Text/Data from the University of Illinois WW2010 Project

Figures 5-11 through 5-13 show the Aerosol Optical Depth[28] over Imperial County as captured by the MODIS instrument onboard the Terra and Aqua satellites on August 19, 2016 and August 21, 2016. Because the exceedances occurred on August 19, 2016 and August 21, 2016 only images related to the amount of particles in the atmosphere for those days are included in this

[28] Aerosol Optical Depth (AOD) (or Aerosol Optical Thickness) indicates the level at which particles in the air (aerosols) prevent light from traveling through the atmosphere. Aerosols scatter and absorb incoming sunlight, which reduces visibility. From an observer on the ground, an AOD of less than 0.1 is "clean" - characteristic of clear blue sky, bright sun and maximum visibility. As AOD increases to 0.5, 1.0, and greater than 3.0, aerosols become so dense that sun is obscured. Sources of aerosols include pollution from factories, smoke from fires, dust from dust storms, sea salt, and volcanic ash and smog. Aerosols compromise human health when inhaled by people, particularly those with asthma or other respiratory illnesses. Source: https://worldview.earthdata.nasa.gov

discussion. Although the Terra satellite made its pass at ~1030 PST which was hours prior to the peak hourly measured concentrations, it does provide supporting evidence of the presence of aerosols in the lower atmosphere. These aerosols more than likely stirred up by gusty winds the preceding evening, August 18, 2016 remained suspended through the morning hours of August 19, 2016.

FIGURE 5-11
TERRA MODIS CAPTURES AEROSOLS IN IMPERIAL COUNTY AUGUST 19, 2016

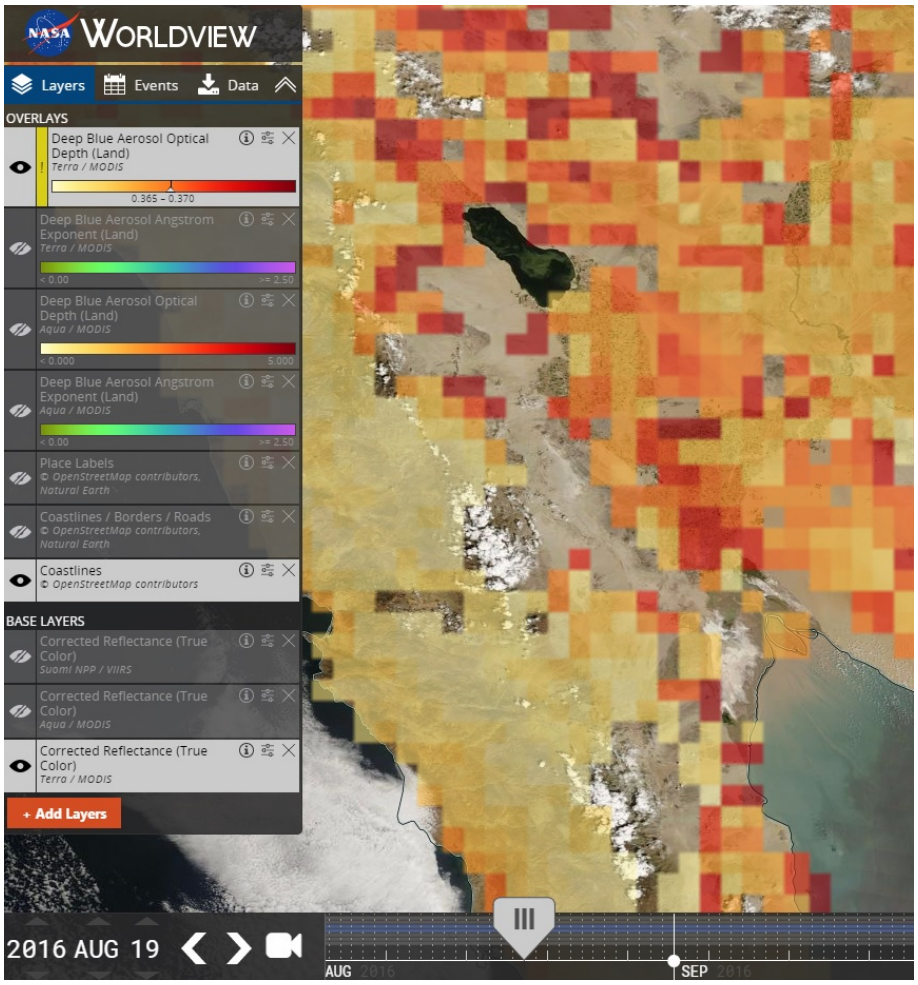


Fig 5-11: Aerosol optical depth over Imperial County as captured by the MODIS instrument aboard the Terra satellite at ~1030 PST. Darker colors indicate thicker AOD. Source: https://worldview.earthdata.nasa.gov

Figure 5-12 is the image captured by the Aqua satellite at around 1330 PST, which utilizes the Deep Blue Aerosol Angstrom Exponent [29] to measure the AOD. This is useful in showing heavier

[29] The MODIS Deep Blue Aerosol Ångström Exponent layer can be used to provide additional information related to the aerosol particle size over land. This layer is created from the Deep Blue (DB) algorithm, originally developed for retrieving over desert/arid land (bright in the visible wavelengths). The Ångström exponent provides additional information on the particle size (larger the exponent, the smaller the particle size). Values < 1 suggest optical dominance of coarse particles (e.g. dust) and values > 1 suggest

aerosols that indicate dust as indicated by green areas in the image. Although the Aqua satellite made its pass prior to peak concentrations, it supports the presence of large-particle aerosols across Imperial County.

FIGURE 5-12
AQUA MODIS CAPTURES AEROSOLS IN IMPERIAL COUNTY AUGUST 19, 2016

Fig 5-12: The MODIS instrument onboard the Aqua satellite captured a thick layer of large particle aerosols drifting over Imperial County at 1330 PST on August 19, 2016. Green colors indicate thicker aerosols that are more likely dust. Source: NASA Worldview; https://worldview.earthdata.nasa.gov

optical dominance of fine particles (e.g. smoke) https://worldview.earthdata.nasa.gov; The Ångström Exponent (denoted as AE or α) is a measure of how the AOD changes relative to the various wavelength of light (known as 'spectral dependence'.) This is related to the aerosol particle size. Roughly speaking, values less than 1 suggest an optical dominance of coarse particles (e.g. dust, ash, sea spray), while values greater than one 1 dominance of fine particles (e.g. smoke, industrial pollution); https://deepblue.gsfc.nasa.gov/science.

FIGURE 5-13
TERRA MODIS CAPTURES AEROSOLS IN IMPERIAL COUNTY AUGUST 21, 2016

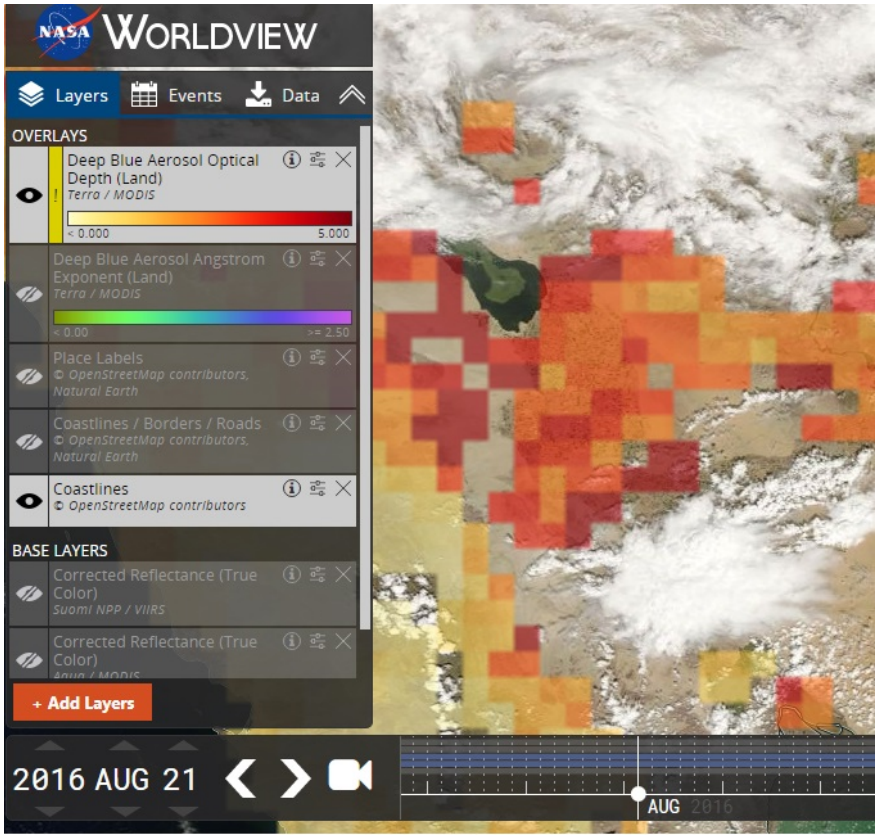


Fig 5-13: The aerosol optical depth over southeast California as captured by the MODIS instrument onboard the Terra satellite at ~1030 PST on August 21, 2016. Source: NASA Worldview; https://worldview.earthdata.nasa.gov

The EPA accepts a high wind threshold for sustained winds of 25 mph in California and 12 other states.[30] **Tables 5-1 through 5-7** provide a temporal relationship of wind speeds, wind direction, wind gusts (if available), and PM_{10} concentrations at the exceeding stations on August 18, 2016, August 19, 2016 and August 21, 2016. The tables include additional wind measurements within the same hour as these short-lived thunderstorms produced quickly moving outflow boundaries, which transported dust into Imperial County. The tables show that peak hourly concentrations took place immediately following or during the period of high upstream wind speeds. While all monitors measured a 24-hour average concentration above 100 µg/m^3 only the Brawley, Westmorland and El Centro monitors exceeded the NAAQS.

[30] "Treatment of Data Influenced by Exceptional Events; Final Guidance", FR Vol. 81, No. 191, 68279, October 3, 2016

TABLE 5-1
BRAWLEY PM_{10} CONCENTRATIONS AND WIND SPEEDS AUGUST 18, 2016

El Centro NAF (KNJK)				Imperial County Airport (KIPL)				Niland			Blythe Airport (KBLH)				Brawley	
HOUR	W/S	W/G	W/D	HOUR	W/S	W/G	W/D	HOUR	W/S	W/D	HOUR	W/S	W/G	W/D	HOUR	PM_{10} (µg/m³)
56	6		210	53	3		210	0:00	5.1	104	52	13		100	0:00	46
156	6		160	153	6		120	1:00	7	108	152	7		50	1:00	37
256	14		130	253	11		130	2:00	10	125	252				2:00	31
356	11		150	353	13		160	3:00	7.1	125	352	3		70	3:00	27
456	11		160	453	10		150	4:00	3.4	116	452	7		40	4:00	17
556	9		160	553	11		140	5:00	2.3	304	552	11		60	5:00	40
656	14		140	653	9		170	6:00	2.4	258	652	6		80	6:00	41
756	11		160	753	11		150	7:00	5.2	199	752	5		90	7:00	43
856	**11**		**150**	**853**	**11**		**170**	**8:00**	**4.1**	**193**	**852**				**8:00**	**140**
956	16		140	953	17	24	150	9:00	6.3	137	952	6		200	9:00	72
1056	11	22	150	1053	11		150	10:00	6.7	184	1052	5		160	10:00	49
1156	7	18	VR	1153	13	21	160	11:00	8	151	1152	15	26	160	11:00	55
1256	3		70	1253	7		90	12:00	6.8	153	1252	11		190	12:00	68
1356	6		130	1353				13:00	5.9	163	1352	8	16	180	13:00	43
1456	7		120	1453	8		90	14:00	4.8	178	1452	11		160	14:00	41
1556	7		VR	1553	8	17	170	15:00	3.5	152	1552	13		170	15:00	37
1656	8		120	1653	11		130	16:00	4.4	155	1652	13		200	16:00	43
1756	11		180	1753	16		170	17:00	4.8	166	1752	8		210	17:00	40
1856	9		150	1853	10		170	18:00	6.5	139	1852	9		230	18:00	43
1956	7	17	190	1953	9		140	19:00	7.2	143	1952	11		230	19:00	44
2056	9		200	2053	7		200	20:00	4.9	146	2052	30	34	40	20:00	53
											2055	30	38	50		
											2058	34	41	50		
											2107	39	46	50		
2156	9		230	2153	8		240	21:00	4.7	97	2121	34	43	60	21:00	49
											2128	34	43	60		
											2156	30	37	60		
											2158	30	37	60		
2256	7		240	2253	9		260	22:00	12	86	2208	26	33	60	22:00	32
											2211	21	33	60		
											2232	23	30	60		
											2254	26	32	60		
2356	**5**		**VR**	**2353**	**7**		**70**	**23:00**	**21.8**	**63**	**2352**	**9**		**20**	**23:00**	**434**

*Wind data for KNJK, KIPL, and KBLH from the NCEI's QCLCD system. Brawley PM_{10} data from AQS. Brawley does not measure wind data. Niland wind data is from the EPA's AQS. Niland does not measure wind gusts data. Wind speeds = mph; Direction = degrees. Blanks indicate no data

TABLE 5-2
WESTMORLAND PM_{10} CONCENTRATIONS AND WIND SPEEDS AUGUST 18, 2016

El Centro NAF (KNJK)				Imperial County Airport (KIPL)				Westmorland			Blythe Airport (KBLH)				Westmorland	
HOUR	W/S	W/G	W/D	HOUR	W/S	W/G	W/D	HOUR	W/S	W/D	HOUR	W/S	W/G	W/D	HOUR	PM_{10} (µg/m³)
56	6		210	53	3		210	0:00	3.1	111	52	13		100	0:00	63
156	6		160	153	6		120	1:00	4.2	103	152	7		50	1:00	45
256	14		130	253	11		130	2:00	8.1	117	252				2:00	31
356	11		150	353	13		160	3:00	6.5	147	352	3		70	3:00	21
456	11		160	453	10		150	4:00	5.5	157	452	7		40	4:00	30
556	9		160	553	11		140	5:00	2.8	85	552	11		60	5:00	41
656	14		140	653	9		170	6:00	3.7	179	652	6		80	6:00	50
756	11		160	753	11		150	7:00	7.1	165	752	5		90	7:00	54
856	**11**		**150**	**853**	**11**		**170**	**8:00**	**7.2**	138	**852**				**8:00**	**131**
956	16		140	953	17	24	150	9:00	6.2	139	952	6		200	9:00	86
1056	11	22	150	1053	11		150	10:00	7.7	139	1052	5		160	10:00	58
1156	7	18	VR	1153	13	21	160	11:00	6.6	148	1152	15	**26**	160	11:00	52
1256	3		70	1253	7		90	12:00	5.6	177	1252	11		190	12:00	55
1356	6		130	1353				13:00	4.7	175	1352	8	16	180	13:00	52
1456	7		120	1453	8		90	14:00	3.1	137	1452	11		160	14:00	47
1556	7		VR	1553	8	17	170	15:00	3.9	122	1552	13		170	15:00	42
1656	8		120	1653	11		130	16:00	5.5	123	1652	13		200	16:00	39
1756	11		180	1753	16		170	17:00	6	138	1752	8		210	17:00	61
1856	**9**		150	**1853**	**10**		170	**18:00**	**5.5**	148	**1852**	**9**		230	**18:00**	**111**
1956	**7**	**17**	190	**1953**	**9**		140	**19:00**	**5.2**	138	**1952**	**11**		230	**19:00**	**110**
2056	9		200	2053	7		200	20:00	1.9	201	2052	**30**	**34**	40	20:00	46
											2055	**30**	**38**	50		
											2058	**34**	**41**	50		
											2107	**39**	**46**	50		
2156	9		230	2153	8		240	21:00	2.5	198	2121	**34**	**43**	60	21:00	65
											2128	**34**	**43**	60		
											2156	**30**	**37**	60		
											2158	**30**	**37**	60		
2256	7		240	2253	9		260	22:00	1.3	287	2208	**26**	**33**	60	22:00	26
											2211	21	**33**	60		
											2232	23	**30**	60		
											2254	**26**	**32**	60		
2356	**5**		**VR**	**2353**	**7**		**70**	23:00	**10.3**	**70**	**2352**	**9**		**20**	**23:00**	**770**

*Wind data for KNJK, KIPL, and KBLH from the NCEI's QCLCD system. Westmorland PM_{10} data from AQS. Westmorland wind data is from the EPA's AQS. Westmorland does not measure wind gusts. Wind speeds = mph; Direction = degrees. Blanks indicate no data

TABLE 5-3
NILAND PM_{10} CONCENTRATIONS AND WIND SPEEDS AUGUST 18, 2016

El Centro NAF (KNJK)				Imperial County Airport (KIPL)				Niland			Blythe Airport (KBLH)				Niland	
HOUR	W/S	W/G	W/D	HOUR	W/S	W/G	W/D	HOUR	W/S	W/D	HOUR	W/S	W/G	W/D	HOUR	PM_{10} ($\mu g/m^3$)
56	6		210	53	3		210	0:00	5.1	104	52	13		100	0:00	19
156	6		160	153	6		120	1:00	7	108	152	7		50	1:00	33
256	14		130	253	11		130	2:00	10	125	252				2:00	26
356	11		150	353	13		160	3:00	7.1	125	352	3		70	3:00	16
456	11		160	453	10		150	4:00	3.4	116	452	7		40	4:00	51
556	9		160	553	11		140	5:00	2.3	304	552	11		60	5:00	26
656	14		140	653	9		170	6:00	2.4	258	652	6		80	6:00	30
756	11		160	753	11		150	7:00	5.2	199	752	5		90	7:00	81
856	11		150	853	11		170	8:00	4.1	**193**	852				8:00	98
956	**16**		**140**	**953**	**17**	**24**	**150**	**9:00**	**6.3**	**137**	**952**	**6**		**200**	**9:00**	**183**
1056	**11**	**22**	**150**	**1053**	**11**		**150**	**10:00**	**6.7**	**184**	**1052**	**5**		**160**	**10:00**	**106**
1156	7	**18**	VR	1153	13	**21**	160	11:00	8	151	1152	15	**26**	160	11:00	57
1256	3		70	1253	7		90	12:00	6.8	153	1252	11		190	12:00	59
1356	6		130	1353				13:00	5.9	163	1352	8	**16**	180	13:00	61
1456	7		120	1453	8		90	14:00	4.8	178	1452	11		160	14:00	63
1556	7		VR	1553	8	**17**	170	15:00	3.5	152	1552	13		170	15:00	46
1656	8		120	1653	11		130	16:00	4.4	155	1652	13		200	16:00	51
1756	11		180	1753	16		170	17:00	4.8	166	1752	8		210	17:00	41
1856	9		150	1853	10		170	18:00	6.5	139	1852	9		230	18:00	48
1956	7	17	190	1953	9		140	19:00	7.2	143	1952	11		230	19:00	54
2056	9		**200**	**2053**	7		**200**	**20:00**	4.9	**146**	**2052**	**30**	**34**	40	**20:00**	**126**
											2055	**30**	**38**	50		
											2058	**34**	**41**	50		
											2107	**39**	**46**	50		
2156	9		230	2153	8		240	21:00	4.7	97	2121	**34**	**43**	60	21:00	59
											2128	**34**	**43**	60		
											2156	**30**	**37**	60		
											2158	**30**	**37**	60		
2256	**7**		**240**	**2253**	**9**		**260**	**22:00**	**12**	**86**	**2208**	**26**	**33**	60	**22:00**	**995**
											2211	**21**	**33**	60		
											2232	**23**	**30**	60		
											2254	**26**	**32**	60		
2356	**5**		**VR**	**2353**	**7**		**70**	**23:00**	**21.8**	**63**	**2352**	**9**		**20**	**23:00**	**995**

*Wind data for KNJK, KIPL, and KBLH from the NCEI's QCLCD system. Niland PM_{10} data from AQS. Niland wind data is from the EPA's AQS. Niland does not measure wind gust data. Wind speeds = mph; Direction = degrees Blanks indicated no data

TABLE 5-4
BRAWLEY PM_{10} CONCENTRATIONS AND WIND SPEEDS AUGUST 19, 2016

Sunrise-Ocotillo (IMPSD)				Constitucion de 1857 Laguna Hanson (CLHB1)				El Centro NAF (KNJK)				Imperial County Airport (KIPL)				Brawley	
HOUR	W/S	W/G	W/D	HOUR	W/S	W/G	W/D	HOUR	W/S	W/G	W/D	HOUR	W/S	W/G	W/D	HOUR	PM_{10} ($\mu g/m^3$)
0:00	9	15	251	0:00	3	7	22	56	7		50	53	5		70	0:00	184
1:00	6	10	217	1:00	1	3	255	156				153	5		100	1:00	52
2:00	10	12	309	2:00	1	4	107	256				253	5		160	2:00	120
3:00	6	10	302	3:00	1	3	155	356	3		10	353	5		270	3:00	138
4:00	4	6	242	4:00	5	21	40	456				453				4:00	110
5:20	5	7	250	5:00	4	18	10	556	3		50	553				5:00	104
6:00	3	4	267	6:00	3	7	48	656	3		80	653	8		70	6:00	199
7:10	5	7	349	7:00	6	12	59	756	8		90	753	7		80	7:00	90
8:00	3	6	314	8:00				856	9		120	853	10		150	8:00	51
9:00	5	10	87	9:00	2	6	67	956	6		70	953			M	9:00	54
10:00	6	12	82	10:30	5	13	26	1056	5		VR	1053	10		110	10:00	39
11:00	8	17	85	11:00	6	10	164	1156				1153	6		30	11:00	42
12:00	9	17	74	12:00	10	22	116	1256				1253	10		70	12:00	42
13:00	7	18	109	13:30	13	26	53	1356	6		120	1353			M	13:00	29
14:40	7	15	93	14:00	11	27	51	1456	7		110	1453	5		VR	14:00	32
15:10	6	12	60	15:00	5	17	31	1556				1553				15:00	34
16:00	5	9	142	16:00	4	15	4	1656	7		160	1653	11		160	16:00	33
								1700	23	31	180	1702	23	31	200		
								1703	30	40	180	1704	26	32	200		
								1710	29	40	180	1724	25	34	200		
17:00	20	41	139	17:00	3	7	22	1715	31	37	180	1733	22	32	200	17:00	995
								1723	22		180	1737	23	32	200		
								1756	13		200	1753	20	26	210		
18:10	13	18	185	18:00	5	11	274	1856	9		180	1853	11		200	18:00	241
19:00	13	19	235	19:00	3	13	279	1956	7		190	1953	8		220	19:00	376
20:00	11	18	242	20:00	11	19	167	2056	10		210	2053	7		210	20:00	258
21:00	14	20	244	21:00	7	12	59	2156	11		240	2153	8		240	21:00	219
22:00	9	14	253	22:00	6	11	67	2256	20		130	2253	18		140	22:00	147
23:00	7	12	246	23:00	7	11	69	2356	11		120	2353	13		130	23:00	148

*Wind data for KNJK and KIPL from the NCEI's QCLCD system. Brawley PM_{10} data from AQS. Brawley does not measure wind data. Wind data for Sunrise-Ocotillo (IMPSD) and Constitucion de 1857/Laguna Hanson (CLHB1) from the University of Utah's MesoWest. Wind speeds = mph; Direction = degrees Blanks indicate no data

TABLE 5-5
WESTMORLAND PM_{10} CONCENTRATIONS AND WIND SPEEDS AUGUST 19, 2016

Sunrise-Ocotillo (IMPSD)				Laguna Salada, MX (IBCLARUM2)				El Centro NAF (KNJK)				Imperial County Airport (KIPL)				Westmorland	
HOUR	W/S	W/G	W/D	HOUR	W/S	W/G	W/D	HOUR	W/S	W/G	W/D	HOUR	W/S	W/G	W/D	HOUR	PM_{10} ($\mu g/m^3$)
0:00	9	15	251	0:01	19		225	56	7		50	53	5		70	0:00	161
1:00	6	10	217	1:16			360	156				153	5		100	1:00	139
2:00	10	12	309	2:01	9		240	256				253	5		160	2:00	72
3:00	6	10	302	3:01	1		240	356	3		10	353	5		270	3:00	102
4:00	4	6	242	4:01			30	456				453				4:00	116
5:20	5	7	250	5:02	6		340	556	3		50	553				5:00	
6:00	3	4	267	6:02	5		340	656	3		80	653	8		70	6:00	182
7:10	5	7	349	7:02	6		60	756	8		90	753	7		80	7:00	135
8:00	3	6	314	8:02	5		60	856	9		120	853	10		150	8:00	61
9:00	5	10	87	9:02	4		90	956	6		70	953			M	9:00	50
10:00	6	12	82	10:02	2		30	1056	5		VR	1053	10		110	10:00	43
11:00	8	17	85	11:03	6		90	1156				1153	6		30	11:00	34
12:00	9	17	74	12:18	9		45	1256				1253	10		70	12:00	38
13:00	7	18	109	13:03	1		340	1356	6		120	1353			M	13:00	37
14:40	7	15	93	14:03	6		340	1456	7		110	1453	5		VR	14:00	35
15:10	6	12	60	15:03	6		90	1556				1553				15:00	37
16:00	5	9	142	16:03	2		360	1656	7		160	1653	11		160	16:00	40
17:00	20	41	139	17:03	27		135	1700	23	31	180	1702	23	31	200	17:00	995
								1703	30	40	180	1704	26	32	200		
								1710	29	40	180	1724	25	34	200		
								1715	31	37	180	1733	22	32	200		
								1723	22		180	1737	23	32	200		
								1756	13		200	1753	20	26	210		
18:10	13	18	185	18:03	18		225	1856	9		180	1853	11		200	18:00	358
19:00	13	19	235	19:03	20		210	1956	7		190	1953	8		220	19:00	304
20:00	11	18	242	20:03	24		210	2056	10		210	2053	7		210	20:00	265
21:00	14	20	244	21:03	11		210	2156	11		240	2153	8		240	21:00	192
22:00	9	14	253	22:04	13		210	2256	20		130	2253	18		140	22:00	190
23:00	7	12	246	23:04	9		160	2356	11		120	2353	13		130	23:00	194

*Wind data for KNJK and KIPL from the NCEI's QCLCD system. Westmorland PM_{10} data from AQS. Westmorland does not measure wind gust data. Wind data for Sunrise-Ocotillo (IMPSD) from the University of Utah's MesoWest. Laguna Salada wind data from the Weather Underground. Wind speeds = mph; Direction = degrees Blanks indicate no data

TABLE 5-6
NILAND PM_{10} CONCENTRATIONS AND WIND SPEEDS AUGUST 19, 2016

Buttercup Ranger Station (BTTC1)				Cahuilla Ranger Station (QCAC1)				El Centro NAF (KNJK)				Imperial County Airport (KIPL)				Niland	
HOUR	W/S	W/G	W/D	HOUR	W/S	W/G	W/D	HOUR	W/S	W/G	W/D	HOUR	W/S	W/G	W/D	HOUR	PM_{10} (µg/m³)
0:09	3	18	123	0:10	16	22	45	56	7		50	53	5		70	0:00	449
1:09	8	13	65	1:10	13	18	71	156				153	5		100	1:00	25
2:09	12	16	61	2:10	13	18	86	256				253	5		160	2:00	28
3:09	9	16	71	3:10	11	15	100	356	3		10	353	5		270	3:00	27
4:09				4:10				456				453				4:00	56
5:09	6	9	181	5:10	1	3	323	556	3		50	553				5:00	88
6:09	4	8	357	6:10	2	5	34	656	3		80	653	8		70	6:00	42
7:09	6	10	350	7:10	5	9	100	756	8		90	753	7		80	7:00	89
8:09	5	8	68	8:10	8	12	102	856	9		120	853	10		150	8:00	46
9:09	4	8	113	9:10				956	6		70	953			M	9:00	109
10:09	8	13	128	10:10	5	13	142	1056	5		VR	1053	10		110	10:00	38
11:09	6	13	127	11:10	7	13	161	1156				1153	6		30	11:00	31
12:09	6	14	121	12:10	6	15	155	1256				1253	10		70	12:00	32
13:09	7	13	130	13:10	7	15	234	1356	6		120	1353			M	13:00	39
14:09	4	14	90	14:10	6	20	197	1456	7		110	1453	5		VR	14:00	82
15:09	4	12	205	15:10	1	14	327	1556				1553				15:00	45
16:09	10	17	176	16:10	1	10	270	1656	7		160	1653	11		160	16:00	34
17:09	17	25	186	17:10	8	15	193	1700	23	31	180	1702	23	31	200	17:00	26
								1703	30	40	180	1704	26	32	200		
								1710	29	40	180	1724	25	34	200		
								1715	31	37	180	1733	22	32	200		
								1723	22		180	1737	23	32	200		
								1756	13		200	1753	20	26	210		
18:09	13	25	178	18:10	14	30	191	1856	9		180	1853	11		200	18:00	798
19:09	3	15	217	19:10	9	26	155	1956	7		190	1953	8		220	19:00	391
20:09	6	11	147	20:10	4	12	13	2056	10		210	2053	7		210	20:00	319
21:09	3	10	149	21:10	4	11	150	2156	11		240	2153	8		240	21:00	284
22:09	11	21	133	22:10	5	8	99	2256	20		130	2253	18		140	22:00	305
23:09	11	18	124	23:10	19	26	145	2356	11		120	2353	13		130	23:00	254

*Wind data for KNJK and KIPL from the NCEI's QCLCD system. Wind data for Buttercup Ranger Station (BTTC) and Cahuilla Ranger Station (QCAC1) from the University of Utah's MesoWest. Wind speeds = mph; Direction = degrees Blanks indicate no data

TABLE 5-7
EL CENTRO PM_{10} CONCENTRATIONS AND WIND SPEEDS AUGUST 21, 2016

Yuma (E5462)				Fort Yuma AZ (FTYA3)				Yuma, AZ MCAS (KNYL)					El Centro			El Centro	
HOUR	W/S	W/G	W/D	HOUR	W/S	W/G	W/D	HOUR	W/S	W/G	W/D	Obs.	HOUR	W/S	W/D	HOUR	PM_{10} ($\mu g/m^3$)
22:09	7	9	143	22:16	7	11	146	2257	16		110		2200	1.1	195	2200	89
23:09	19	24	68	23:16	21	33	69	2307	29	36	60	BLDU	2300	9.1	93	2300	295
								2311	32	39	60						
								2320	24	33	60						
								2347	22	28	90						
								2357	17		90						
0:09	16	22	99	0:16	17	29	81	57	15		90		000	7.2	122	000	750
1:09	13	17	99	1:16	14	27	61	157	22		100		100	6.6	145	100	342
2:09	12	16	108	2:16	10	24	107	257					200	4.8	171	200	487
3:09	3	3	156	3:16	5	9	325	357					300	4.6	188	300	315
4:09	1	3	252	4:16	2	5	294	457	6		300		400	2.5	210	400	260
5:09	2	3	267	5:16	4	9	306	557	3		20		500	4.7	26	500	324
6:09				6:16	2	6	45	657	7		50		600	7.4	29	600	292
7:09	5	6	36	7:16	6	9	36	757	11		40		700	10.3	47	700	199
8:09	8	10	55	8:16	11	17	38	857	16		50		800	9.8	57	800	83
9:09	10	13	45	9:16	12	17	49	957	11		50		900	5.2	93	900	84
10:12	7	10	44	10:16	13	18	59	1057	9		90		1000	4.6	162	1000	69
11:09	3	5	83	11:16	7	16	95	1157	6		160		1100	3.5	125	1100	69
12:09	2	5	95	12:16	7	11	187	1257	9		190		1200	2.1	132	1200	74
13:09	6	8	199	13:16	8	19	201	1357	9		210		1300	2.1	158	1300	61
14:09	2	4	206	14:16	7	13	146	1457	8		120		1400	2.7	108	1400	41
15:09	8	11	148	15:16	5	15	185	1557					1500	2.1	141	1500	35
16:09	6	8	195	16:16	6	12	135	1657	11		180		1600	1.4	122	1600	33
17:09	7	9	215	17:16	8	18	243	1757	9		190		1700	3.1	225	1700	33
18:09	4	6	236	18:16	5	14	211	1857	7		260		1800	4.3	158	1800	41
19:09	4	5	222	19:16	8	15	234	1957	6		250		1900	3.2	176	1900	98
20:09	4	7	209	20:16	4	10	212	2057	7		170		2000	2.4	228	2000	92
21:09	5	7	168	21:16	4	8	147	2157	9		180		2100	2.6	155	2100	106
22:09	5	6	143	22:16	7	10	147	2257	8		180		2200	3	191	2200	123
23:09	4	5	152	23:16	8	12	163	2357	5		190		2300	4.5	240	2300	87

*Wind data for KNYL from the NCEI's QCLCD system. El Centro PM_{10} and wind data from AQS. El Centro does not measure wind gusts. Yuma (E5462) and Fort Yuma (FTYA3) wind data from the University of Utah's MesoWest. Wind speeds = mph; Direction = degrees. BLDU= blowing dust. First two rows indicate August 20, 2016 final hours of the day Blanks indicate no data

As discussed in previous sections, an uncommon weather pattern that lasted several days affected Imperial, San Diego, Riverside and Yuma counties. The presence of a Pacific ridge over Southern California and a trough near the central California coast created a cooling effect that allowed the intrusion of moisture into the region. Along with the influence from the jet stream, a series of shortwaves created the ideal conditions for thunderstorms in Arizona and northern

Mexico. The meteorological conditions were ideal for what the San Diego NWS described as erratic and short-lived thunderstorms that reached the San Diego, Riverside, Imperial and Yuma counties. In essence, on August 19, 2016 thunderstorms developed along the San Diego and Imperial County lines while outflow boundaries from thunderstorm development from the east and from the south affected the desert southwest on August 21, 2016, which affected air quality and caused an exceedance at the Brawley, El Centro and Westmorland monitors.

As discussed earlier locally measured elevated winds coincided with elevated particulate matter in Imperial County. The strongest measured winds on August 19, 2016 occurred at 1700 PST with winds gusts ranging between 26 and 40 mph during the 1700 PST hour. On August 20, 2016, winds remained moderate at the Yuma MCAS with the highest winds measured during the evening hours. While the Blythe Airport measured, continued moderate level winds throughout the day the Imperial County Airport and the El Centro NAF measured elevated winds only during the evening hours through the early morning hours of August 21, 2016. The Yuma MCAS similarly measured elevated winds during the morning hours of August 21, 2016.

In northern Mexico, the available data indicated that winds were equally elevated such as at the Laguna Salada (Constitución de 1857/Laguna Hanson), west of Imperial County. To the south and southeast of Imperial County elevated winds and gusts measured in Mexicali, the Mexicali Airport and San Luis Rio Colorado all are consistent with short intermittent elevated winds and gusts.

In all instances, these winds while short-lived and erratic were sufficient to allow windblown dust to affect air quality in Imperial County and cause an exceedance at the Brawley and Westmorland monitors on August 19, 2016 and the El Centro monitor on August 21, 2016. Likewise, these thunderstorms allowed sufficient moisture to keep windblown dust from causing an exceedance at the Calexico, El Centro, and Niland monitors on August 19, 2016 and an exceedance at the Niland, Westmorland, Brawley and Calexico monitors on August 21, 2016. All monitors measured above 100 $\mu g/m^3$.

Figures 5-14 and 5-15 are reproductions of **Figures 2-29 and 2-30**, which illustrate the existing meteorological conditions that allowed for erratic and short-lived thunderstorm activity on August 19, 2016 and August 21, 2016.

FIGURE 5-14
RAMP-UP ANALYSIS AUGUST 19, 2016

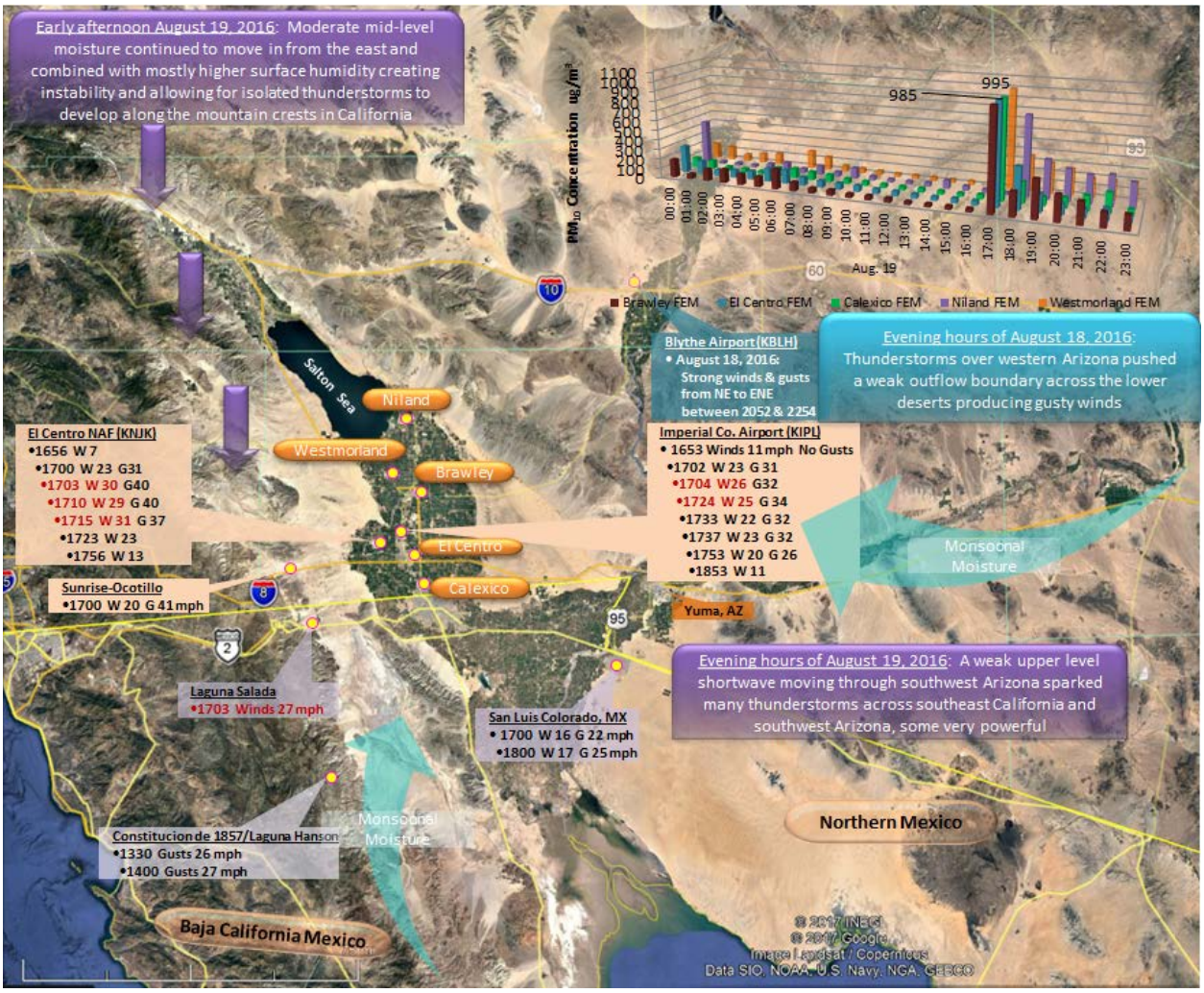


Fig 5-14: Both the Phoenix and San Diego NWS offices described a trough in California with westerly mid/upper winds and several shortwaves that allowed for convection in Arizona. As a result southeast California to south central Arizona came under increasing upper level cyclonic shear as the Jetstream moved further south of the border into Mexico. During the early morning hours of August 19, 2016, thunderstorms over western Arizona pushed a weak outflow boundary across the lower deserts. Storms mostly formed over the crests early afternoon where surface convergence occurred. The convergence moved east into the deserts affecting the San Diego, Imperial County line late afternoon.[31] Descriptions of the evening activity for August 18, 2016 is found in issued Urgent Weather Messages during the late evening hours of August 18, 2016 and Area Forecast Discussion issued early morning August 19, 2016. Google Earth base map

[31] Area Forecast Discussions from the National Weather Service office in San Diego CA, 217 AM PST (317 AM PDT); San Diego CA, 100 PM PST (200 PM PDT); Phoenix AZ, 750 PM PST (850 PM MST), Friday, August 19, 2016

FIGURE 5-15
RAMP-UP ANALYSIS AUGUST 21, 2016

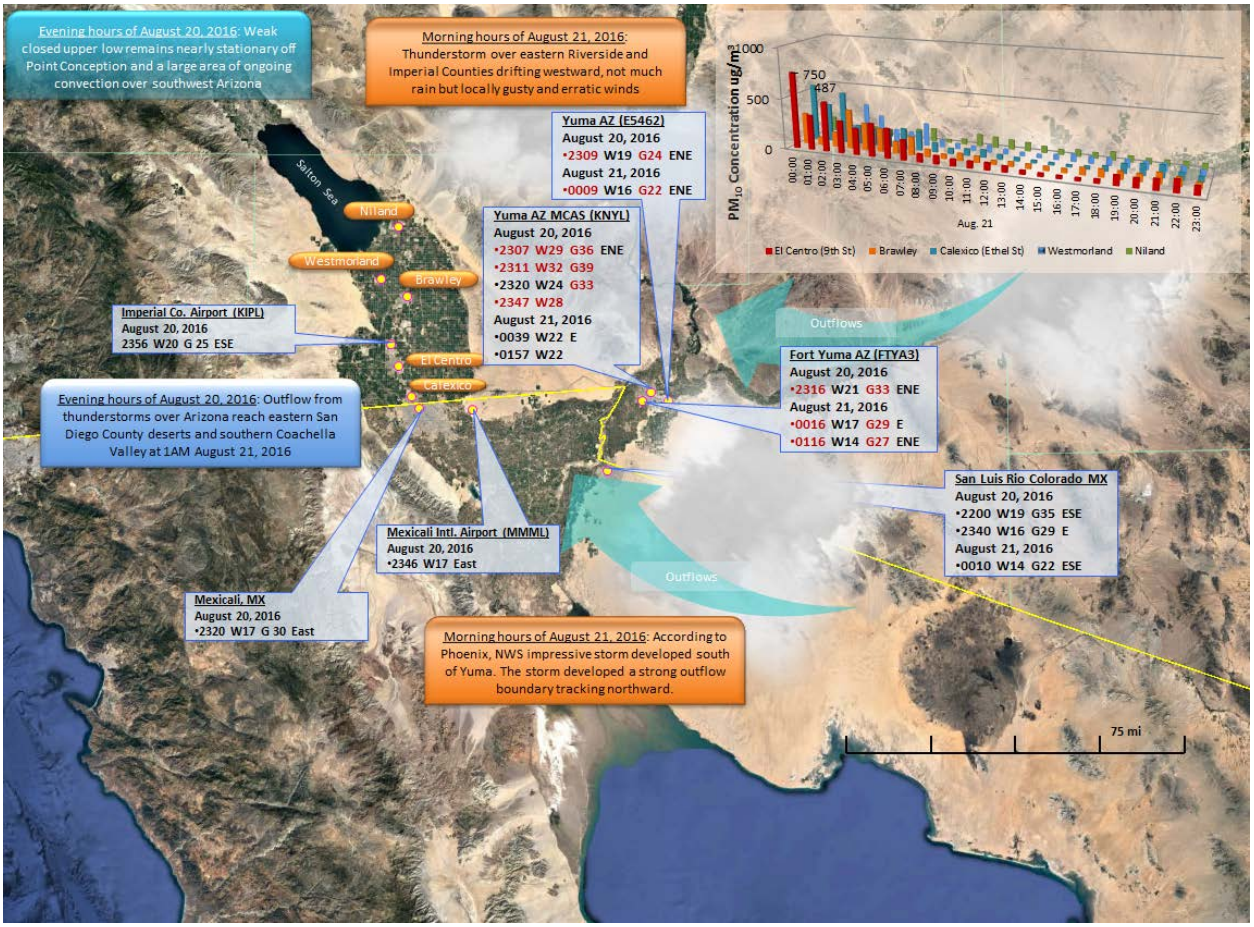


Fig 5-15: According to early morning forecast by the Phoenix NWS office for August 20, 2016, a "pac-man" scenario where rim convection and southeast Arizona mountain convection would both send outflows westward potentially, creating strong convection that would eventually reach the Lower Colorado River Valley. As the upper level trough in California remained relatively stationary, convection continued over most of central Arizona. With the unstable air mass over Yuma County, created days prior, outflow from thunderstorms over Arizona managed to reach eastern Riverside and Imperial Counties shortly after midnight August 21, 2016. These storms drifted westward towards the San Bernardino Mountains while a rather impressive storm developed south of Yuma with outflow tracking northward.[32] Google Earth base map

Figure 5-16 is the depiction of two forward trajectories. Note that airflow originated from northern Mexico but turned east just north of El Centro on August 19, 2016 and west right through El Centro on August 21, 2016. Because there was no exceedance on August 0, 2016 no forward trajectory for August 20, 2016 was included.

[32] Area Forecast Discussions from the National Weather Service office in Phoenix AZ, 745 PM PST (845 PM MST); San Diego CA, 817 PM PST (917 AM PDT) Saturday, August 20, 2016 and Area Forecast Discussions San Diego CA, 227 AM PST (327 AM PDT); San Diego, 754 PM PST (854 PM PDT); Phoenix AZ, 1256 PM PST (156 PM MST), Sunday, August 21, 2016

FIGURE 5-16
FORWARD HYSPLIT TRAJECTORY AUGUST 19, 2016

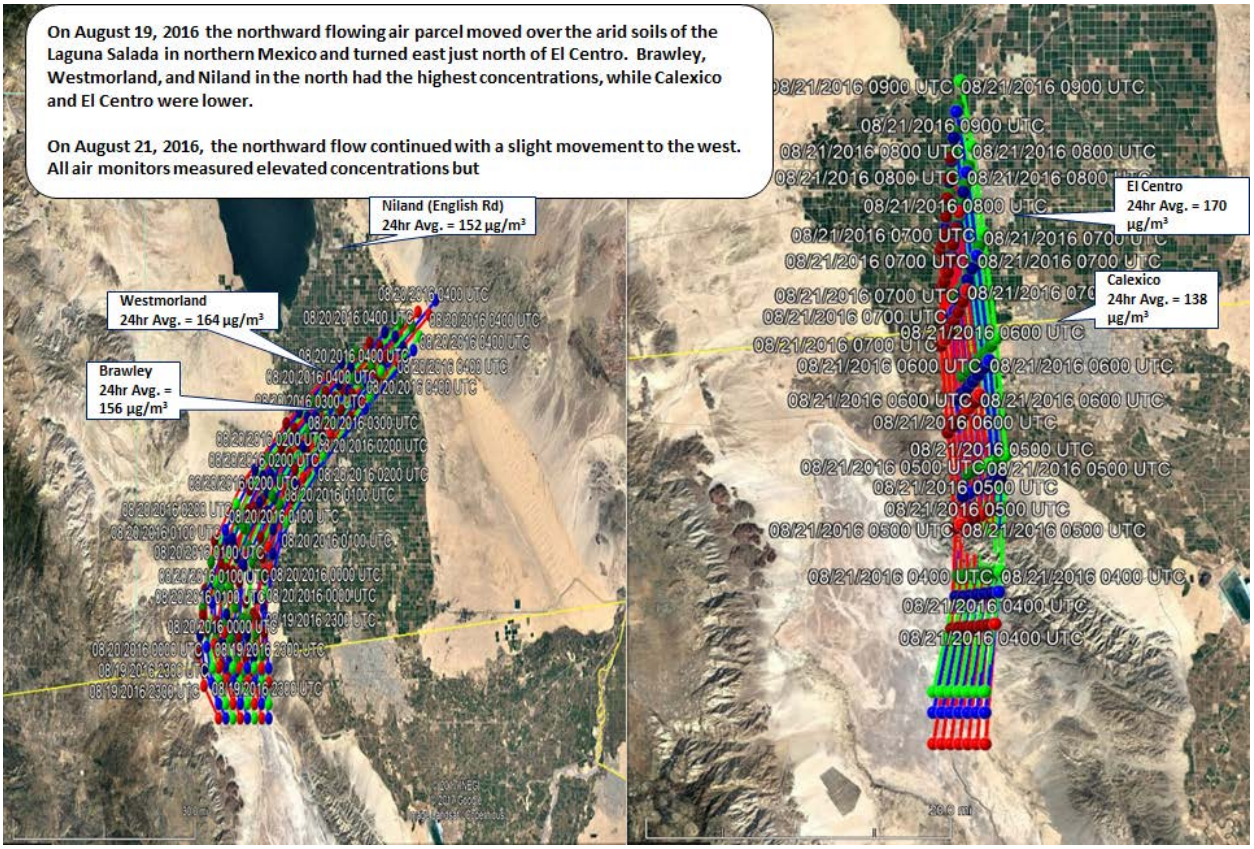


Fig 5-16: A 6-hour HYSPLIT forward trajectory at the 500m level illustrates the general path of the air parcel as it moved northward out of Mexico into Imperial County on August 19, 2016 and August 21, 2016. Dynamically generated through NOAA's Air Resources Laboratory HYSPLIT model. Base map from Google Earth

Figures 5-17 through 5-20 depict PM_{10} concentrations and wind speeds over a 72-hour period at Brawley, Westmorland and El Centro. Fluctuations in hourly concentrations at the monitors over 72 hours show a positive correlation with wind speeds and gusts at upstream sites. As mentioned above, the uncommon August weather pattern affected air quality when windblown dust from areas to the west, southwest, east and south of Imperial County elevated concentrations at all air monitors in Imperial County on August 19, 2016 and August 21, 2016. Although isolated thunderstorm activity was short-lived the formation of these storms was continuous between August 18, 2016 and August 21, 2016 allowing from some rain along isolated areas to the east, west and south of Imperial County. These storms provided not only sufficient winds for elevated concentrations but sufficient moisture to keep saltation and saturation of particulates onto the monitors marginally below an exceedance level at Calexico, El Centro, and Niland on August 19, 2016 and Brawley, Calexico, Niland and Westmorland on August 21, 2016.

FIGURE 5-17
BRAWLEY PM_{10} CONCENTRATIONS & WIND SPEED CORRELATION

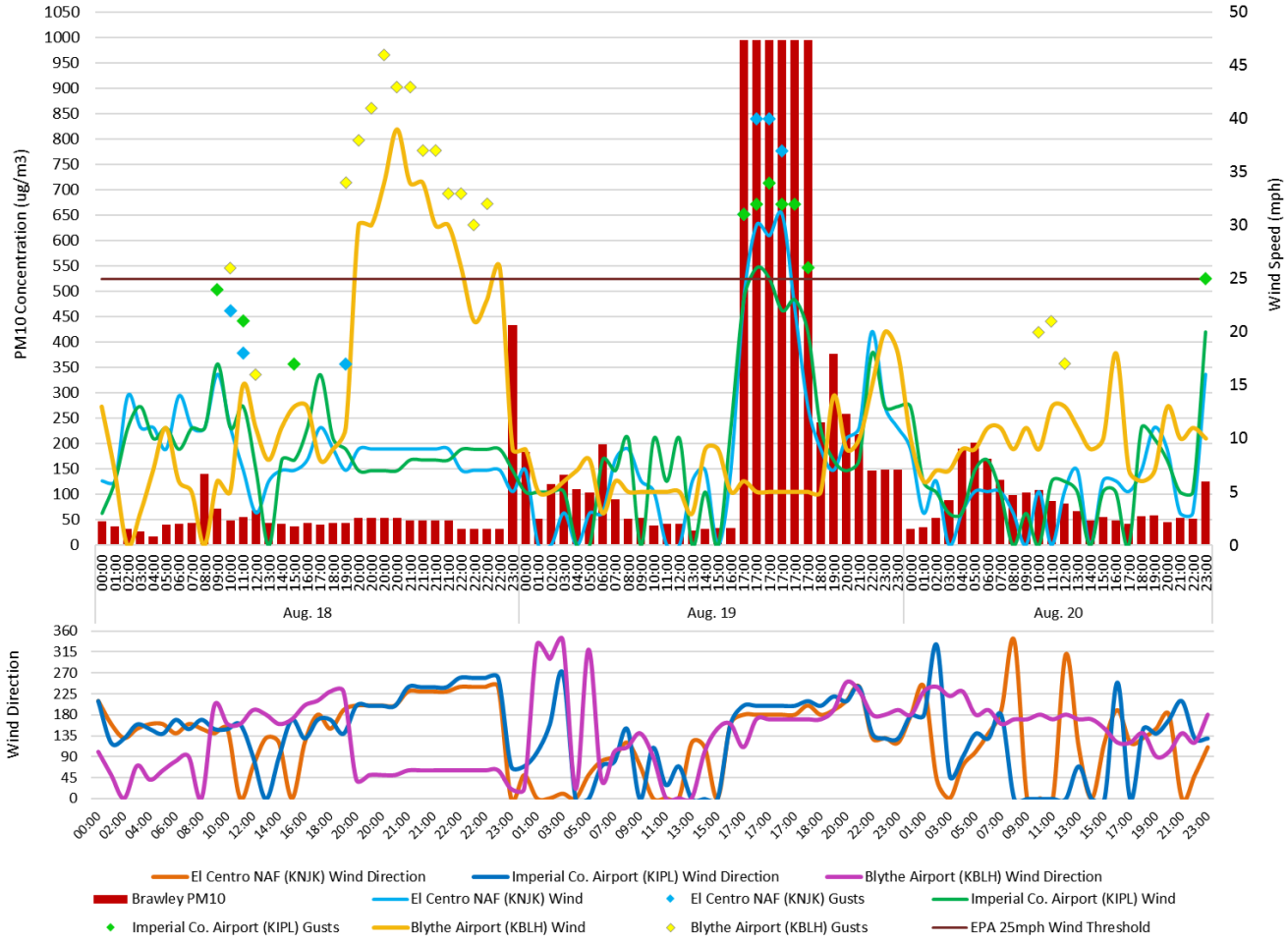


Fig 5-17: Fluctuations in hourly concentrations over 72 hours show a positive correlation with wind speeds, particularly gusts, at Blythe Airport (KBLH) on August 18, 2016 and with the Imperial County Airport (KIPL) and the El Centro NAF (KNJK) on August 19, 2016. The Brawley station does not measure wind. Note the graph included multiple wind measures for a single hour 1700 PST. Note the concentration measurement is not multiple but simply repeated for the 1700 PST hour. The black line indicates 25 mph threshold. Air quality data from the EPA's AQS data bank. Wind data from the NCEI's QCLCD system

FIGURE 5-18
WESTMORLAND PM_{10} CONCENTRATIONS & WIND SPEED CORRELATION

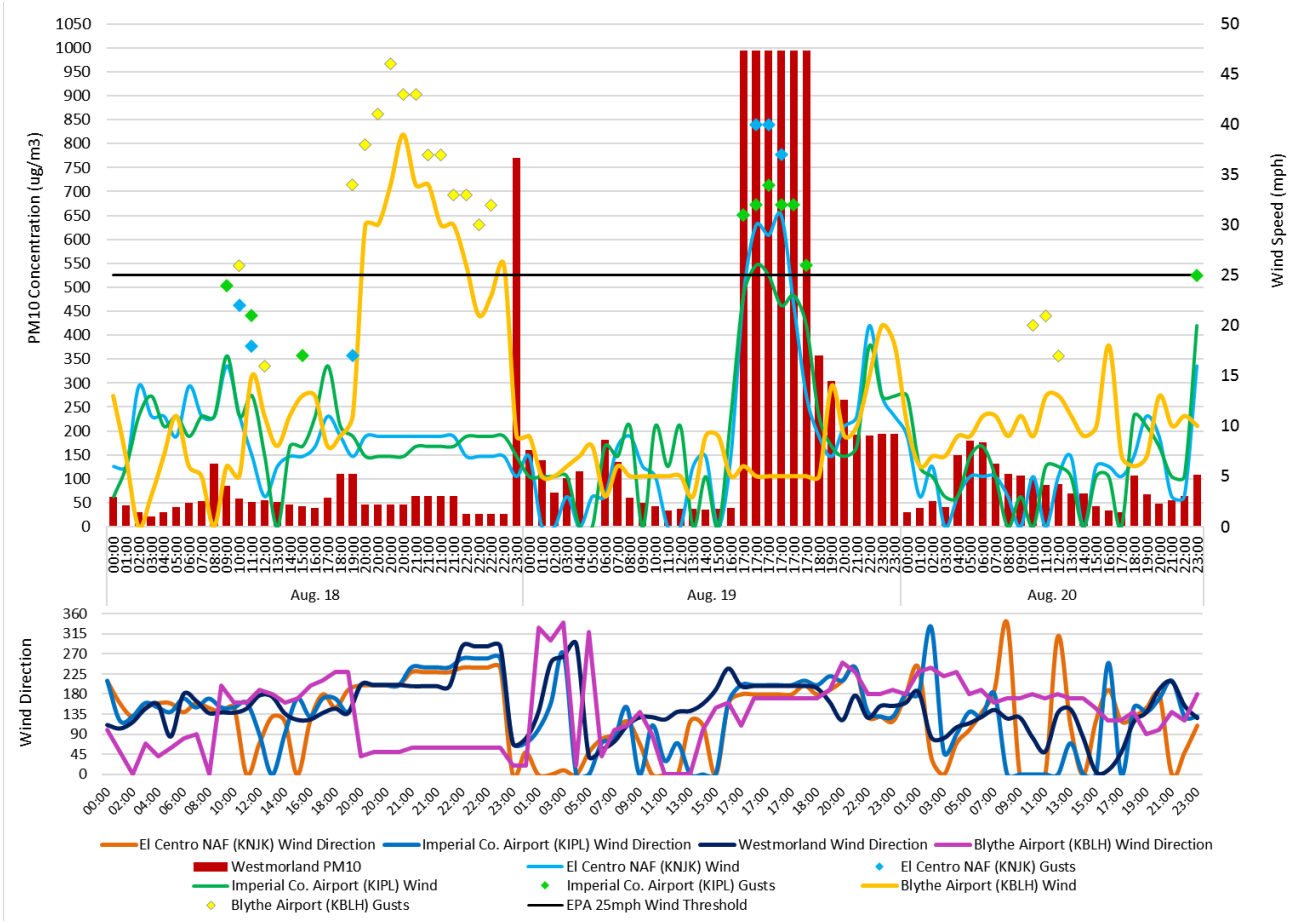


Fig 5-18: Fluctuations in hourly concentrations over 72 hours show a positive correlation with wind speeds, particularly gusts, at Blythe Airport (KBLH) on August 18, 2016 and with the Imperial County Airport (KIPL) and the El Centro NAF (KNJK) on August 19, 2016. . Note the graph included multiple wind measures for a single hour 1700 PST. Note the concentration measurement is not multiple but simply repeated for the 1700 PST hour. The black line indicates 25 mph threshold. Air quality data from the EPA's AQS data bank. Wind data from the NCEI's QCLCD system

FIGURE 5-19
NILAND PM_{10} CONCENTRATIONS & WIND SPEED CORRELATION

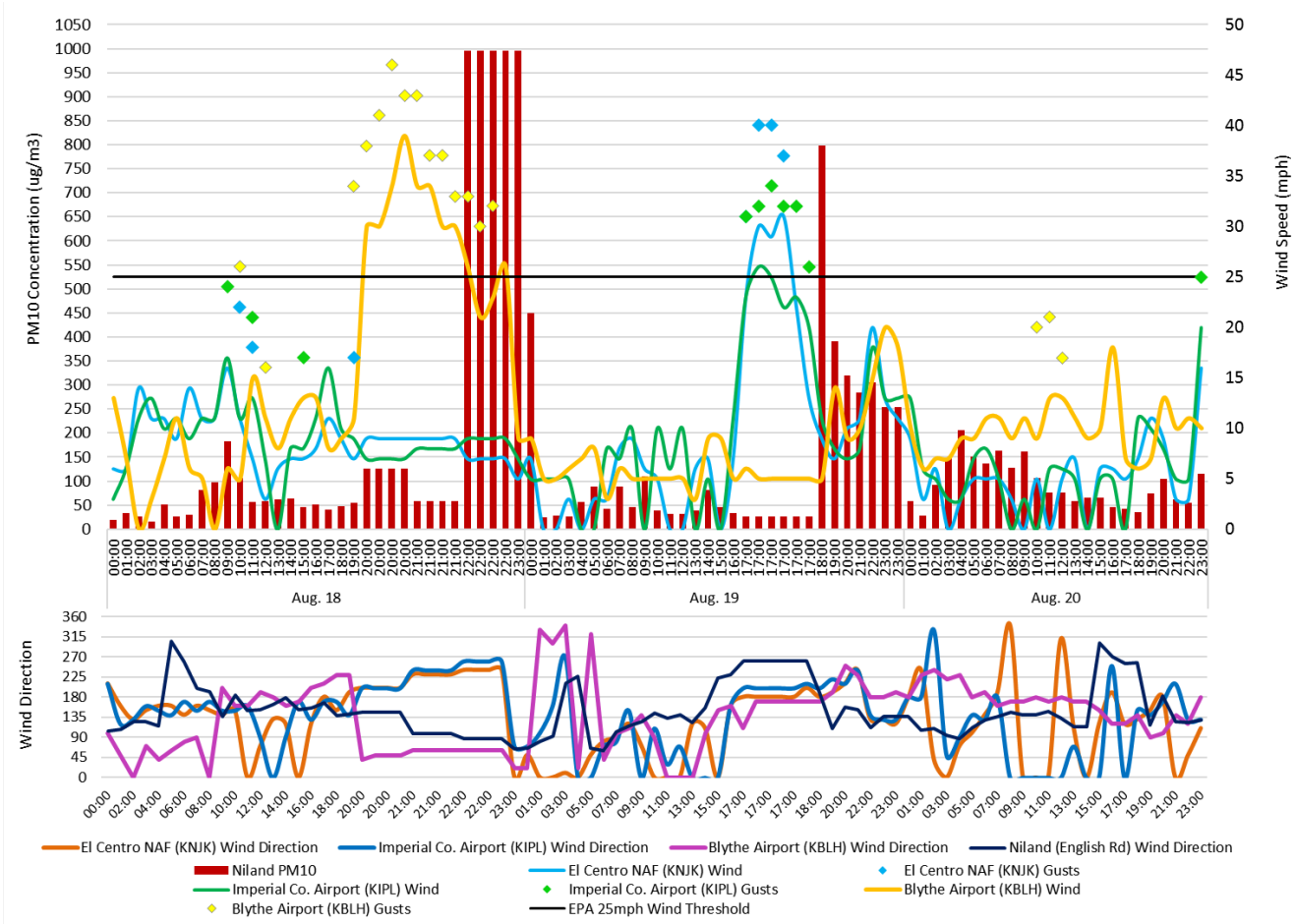


Fig 5-19: Fluctuations in hourly concentrations over 72 hours show a positive correlation with wind speeds, particularly gusts, at Blythe Airport (KBLH) on August 18, 2016 and with the Imperial County Airport (KIPL) and the El Centro NAF (KNJK) on August 19, 2016. . Note the graph included multiple wind measures for a single hour 1700 PST. Note the concentration measurement is not multiple but simply repeated for the 1700 PST hour. The black line indicates 25 mph threshold. Air quality data from the EPA's AQS data bank. Wind data from the NCEI's QCLCD system

FIGURE 5-20
EL CENTRO PM_{10} CONCENTRATIONS & WIND SPEED CORRELATION

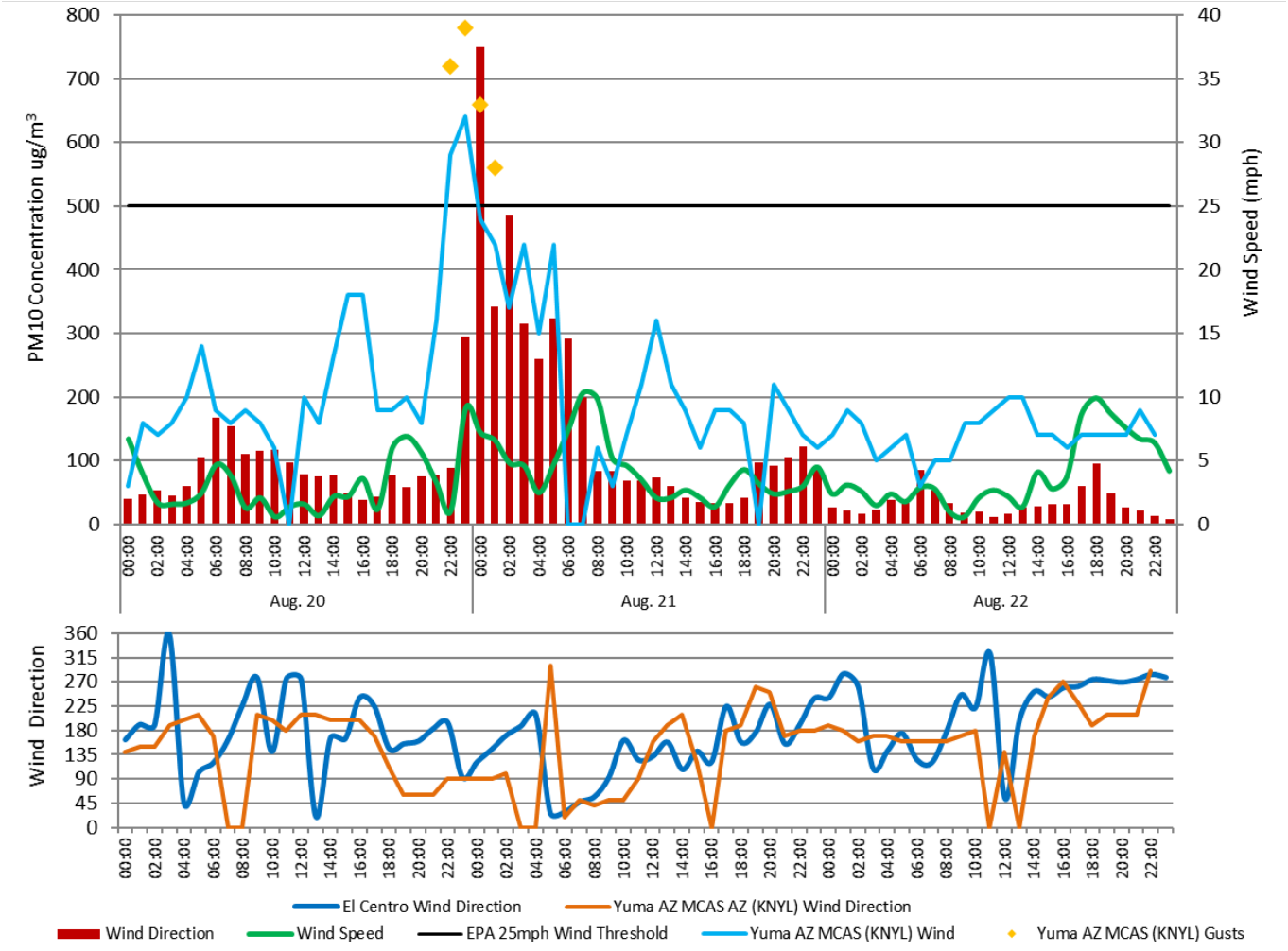


Fig 5-20: Winds at the El Centro monitor remained at moderate levels, however, gusts, which is not measured by the El Centro monitor, played a significant role in causing windblown dust to affect air quality and the air monitors in El Centro. Black line indicates 25 mph threshold. Air quality data from the EPA's AQS data bank. Wind data from the NCEI's QCLCD system

Figures 5-21 and 5-22 depict the 72-hour concentrations at the Brawley, Westmorland and El Centro monitors in correlation with upstream wind speeds. Elevated measured concentrations occur either prior to or during the hours when wind speeds are elevated.

FIGURE 5-21
PM_{10} CONCENTRATIONS & UPSTREAM WIND SPEED CORRELATIONS

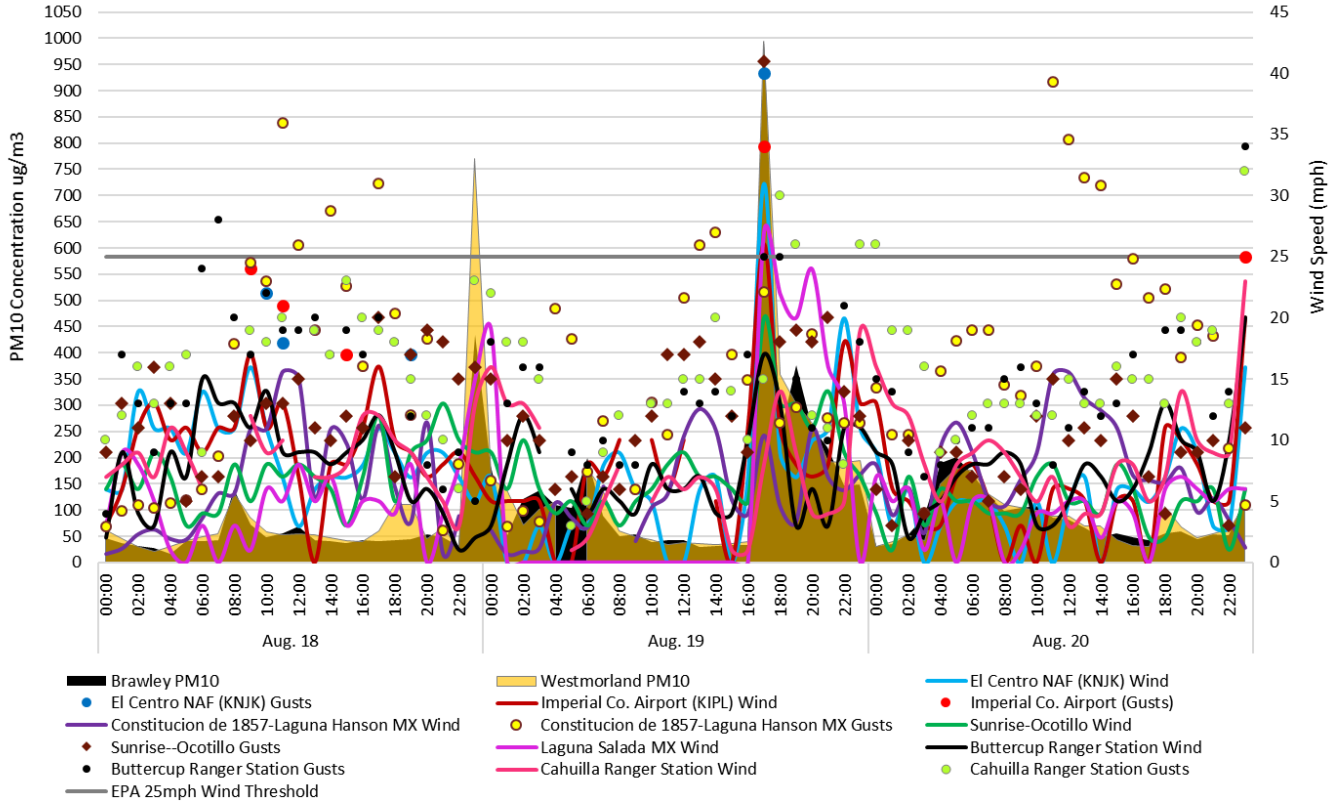


Fig 5-21: This graph depicts the 72-hour PM_{10} fluctuations by the Brawley, Niland (English Rd), and Westmorland monitors together with upstream wind speeds. A positive correlation between elevated wind speeds is evident, particularly with gusts. Black line indicates the 25 mph threshold

FIGURE 5-22
EL CENTRO PM_{10} CONCENTRATIONS & UPSTREAM WIND SPEED CORRELATIONS

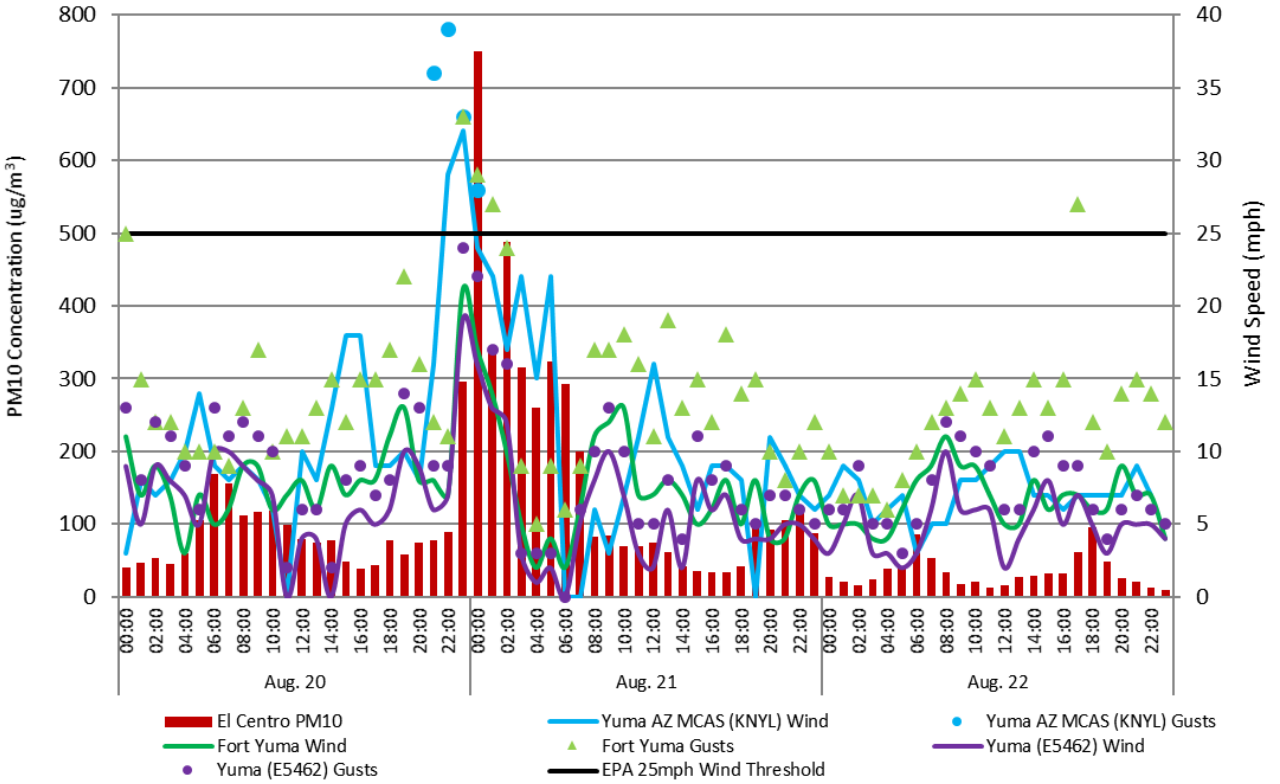


Fig 5-22: This graph depicts the 72-hour PM_{10} fluctuations by the El Centro monitor together with upstream wind speeds. A positive correlation between elevated wind speeds is evident, particularly with gusts. Black line indicates the 25 mph threshold

Figures 5-23 and 5-24 compares the 72-hour concentrations at Brawley, Calexico, El Centro, Westmorland, and Niland with visibility[33] at local airports. Generally, drops in visibility correspond to highest hourly concentrations at the monitors.

[33] According to the NWS there is a difference between human visibility and the visibility measured by an Automated Surface Observing System (ASOS) or an Automated Weather Observing System (AWOS). The automated sensors measure clarity of the air vs. how far one can "see". The more moisture, dust, snow, rain, or particles in the light beam the more light scattered. The sensor measures the return every 30 seconds. The visibility value transmitted is the average 1-minute value from the past 10 minutes. The sensor samples only a small segment of the atmosphere, 0.75 feet therefore an algorithm is used to provide a representative visibility. Siting of the visibility sensor is critical and large areas should provide multiple sensors to provide a representative observation; http://www.nws.noaa.gov/asos/vsby.htm.

FIGURE 5-23
72-HOUR TIME SERIES PM_{10} CONCENTRATIONS AND VISIBILITY
AUGUST 18 TO AUGUST 20

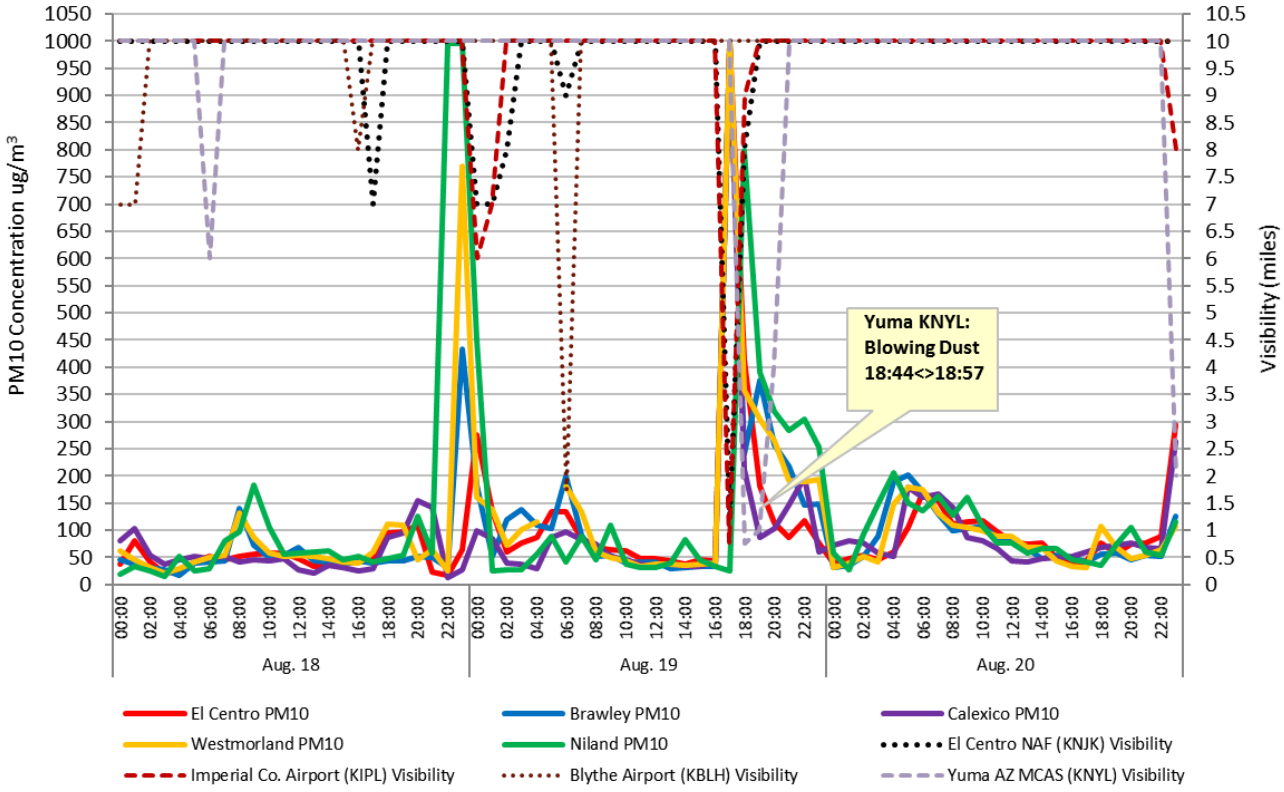


Fig 5-23: Visibility as reported by the Blythe Airport (KBLH), the Imperial County Airport (KIPL), the El Centro NAF (KNJK), and the Yuma MCAS (KNYL) confirm a drop in visibility coincident with peak concentrations at Brawley, Calexico, El Centro, Niland, and Westmorland. The dip in visibility at Blythe around 0600 on August 19, 2016 was due to rain from thunderstorms. Visibility data from the NCEI's QCLCD data bank

FIGURE 5-24
72-HOUR TIME SERIES PM_{10} CONCENTRATIONS AND VISIBILITY
AUGUST 18 TO AUGUST 20

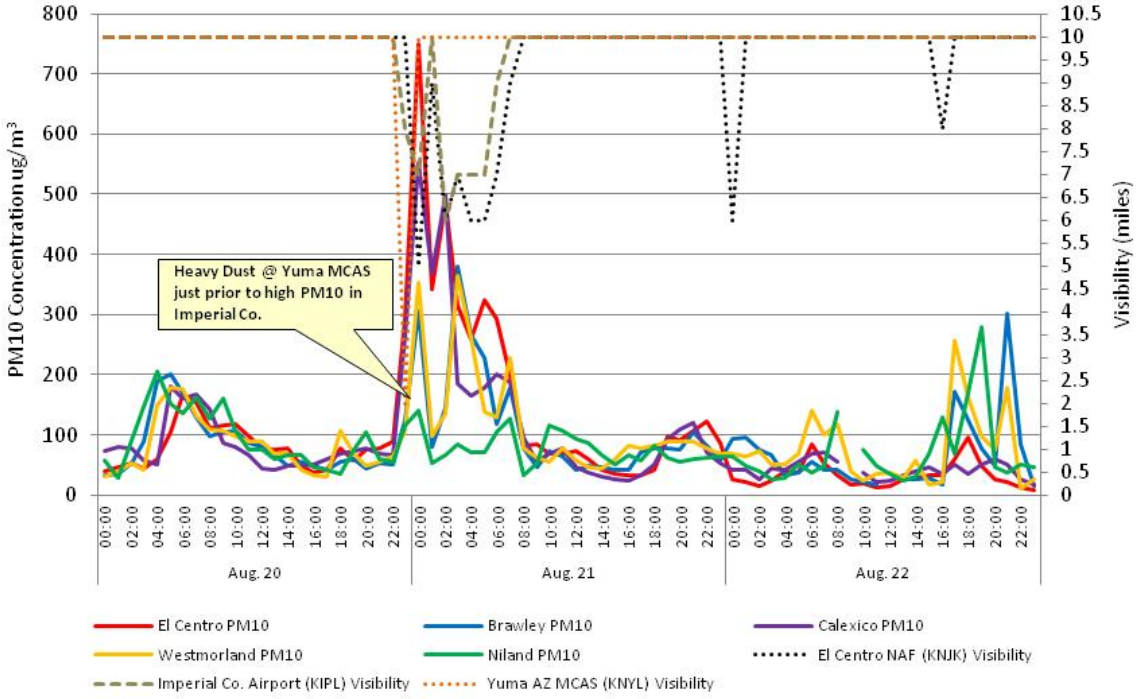


Fig 5-24: Visibility as reported by the Mexicali, Mexico International Airport (MMML), the Imperial County Airport (KIPL), the El Centro NAF (KNJK), and the Yuma MCAS (KNYL) shows a drop in visibility coincident with peak concentrations at Brawley, Calexico, El Centro, and Westmorland. Visibility data from the NCEI's QCLCD data bank

As discussed above, the Phoenix NWS office included no less than 120 notices, such as Bulletins, Preliminary Storm Reports, Flood Advisories, Urgent Weather Messages and Special Weather Statements attesting to the gusty southerly winds, blowing dust and thunderstorm activity.

Figures 5-25 through 5-27 illustrate the level of the Air Quality Index (AQI) in Brawley, Westmorland and El Centro.[34] Air quality remained at predominantly at Moderate or "Yellow" levels with intermittent air quality degradation to Unhealthy for Sensitive Groups or "Orange" as windblown dust from outflow boundaries reached Imperial County from the east and from the south, August 18, 2016 through August 21, 2016. **Appendix A** contains copies of notices pertinent to the August 19, 2016 and August 21, 2016 event.

[34] The AQI is an index for reporting daily air quality. It tells you how clean or polluted your air is, and what associated health effects might be a concern for you. The AQI focuses on health effects you may experience within a few hours or days after breathing polluted air. EPA calculates the AQI for five major air pollutants regulated by the Clean Air Act: ground-level ozone, particle pollution (also known as particulate matter), carbon monoxide, sulfur dioxide, and nitrogen dioxide. For each of these pollutants, EPA has established national air quality standards to protect public health .Ground-level ozone and airborne particles are the two pollutants that pose the greatest threat to human health in this country. Source: https://www.airnow.gov/index.cfm?action=aqibasics.aqi

FIGURE 5-25
IMPERIAL VALLEY AIR QUALITY INDEX IN BRAWLEY
AUGUST 18, 2016 THROUGH AUGUST 21, 2016

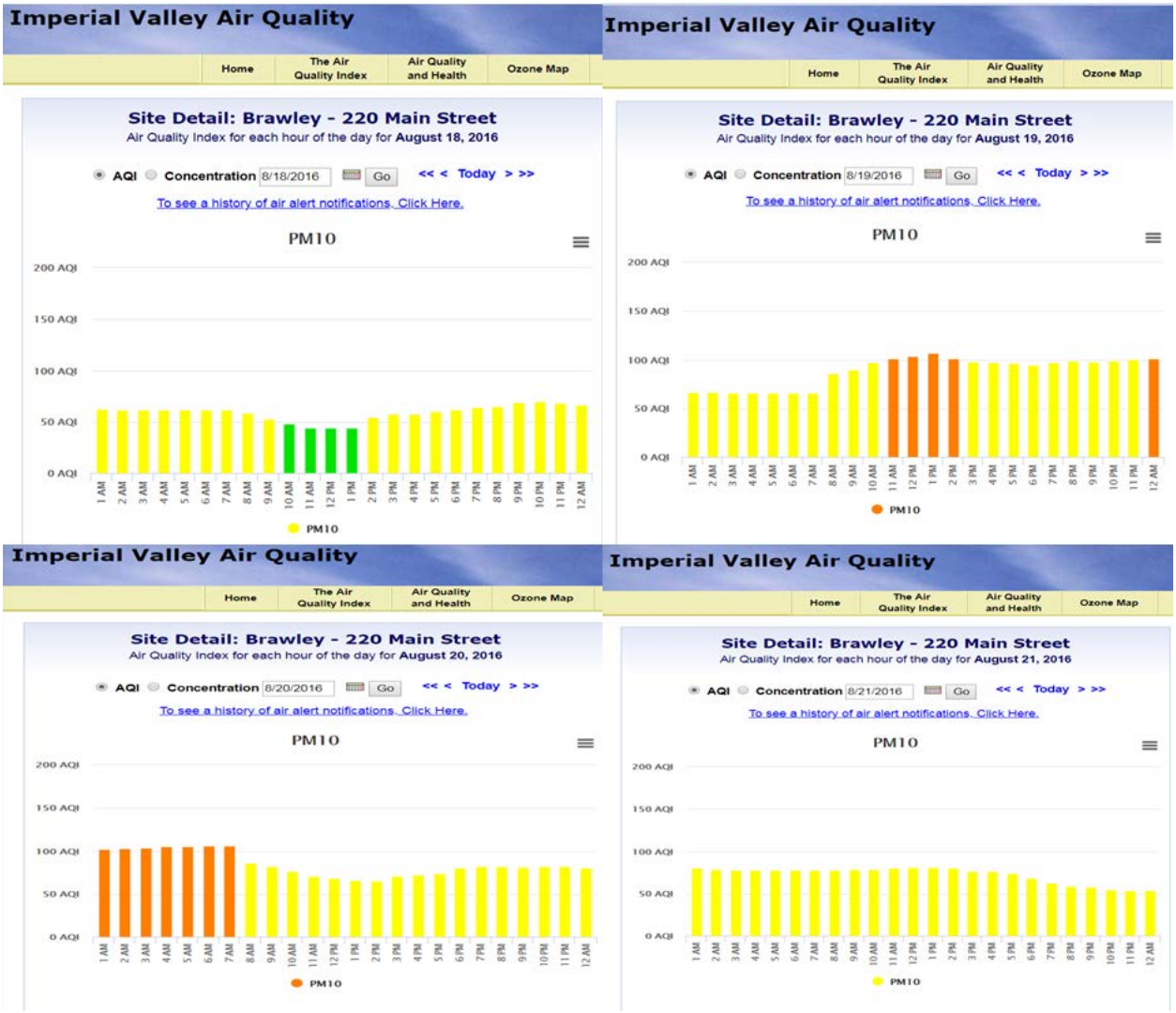


Fig 5-25: Reduced air quality is evident when warning go from Good or "Green" to Moderate or "Yellow" and Unhealthy for Sensitive Groups or "Orange". Source: ICAPCD archives

FIGURE 5-26
IMPERIAL VALLEY AIR QUALITY INDEX IN WESTMORLAND
AUGUST 18, 2016 THROUGH AUGUST 21, 2016

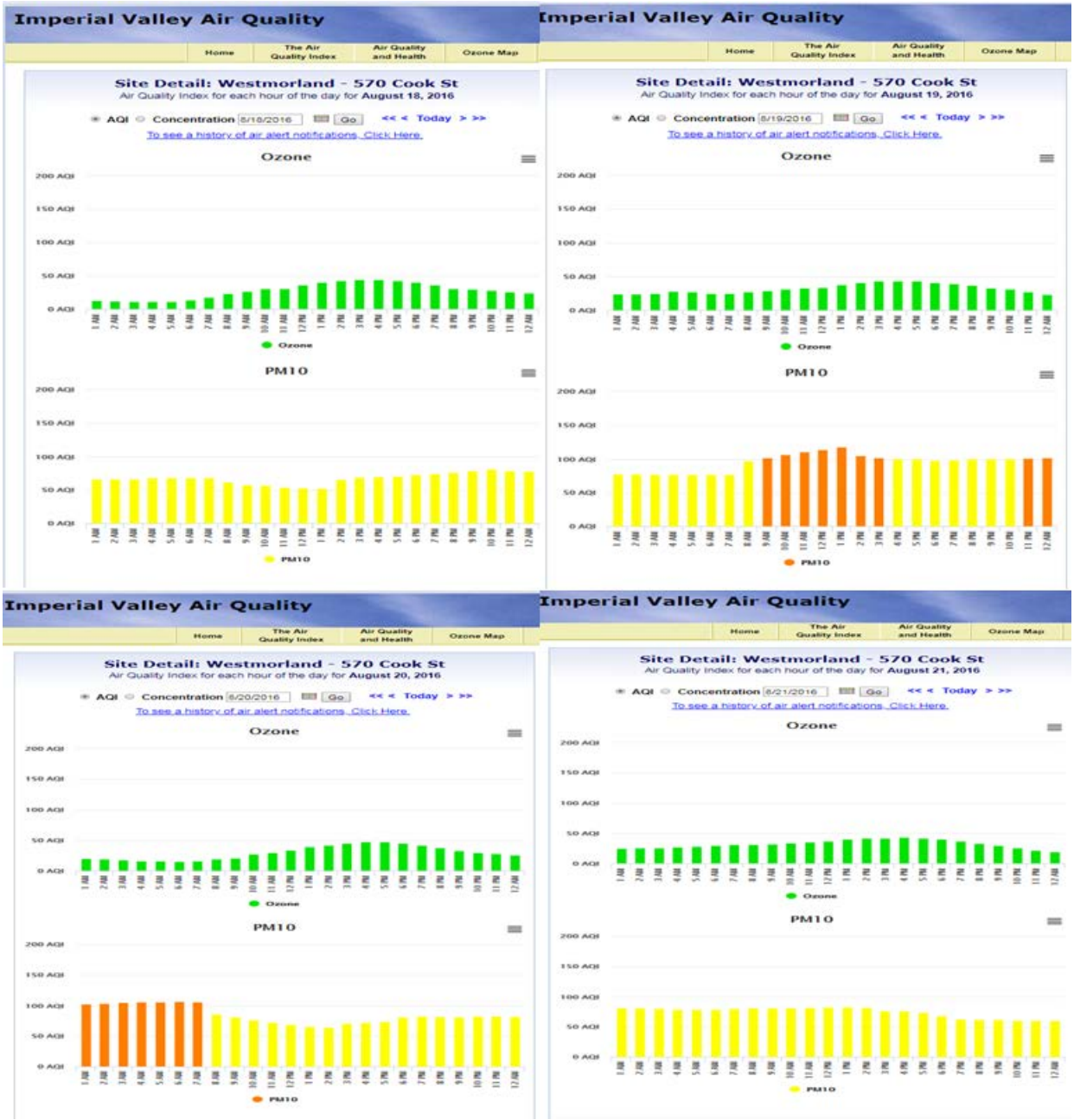


Fig 5-26: Reduced air quality is evident when warning go from Good or "Green" to Moderate or "Yellow" and Unhealthy for Sensitive Groups or "Orange". The top green hourly bars are for Ozone the bottom "Yellow" and "Orange" hourly bars are for PM_{10}. Source: ICAPCD archives

FIGURE 5-27
IMPERIAL VALLEY AIR QUALITY INDEX IN EL CENTRO
AUGUST 18, 2016 THROUGH AUGUST 21, 2016

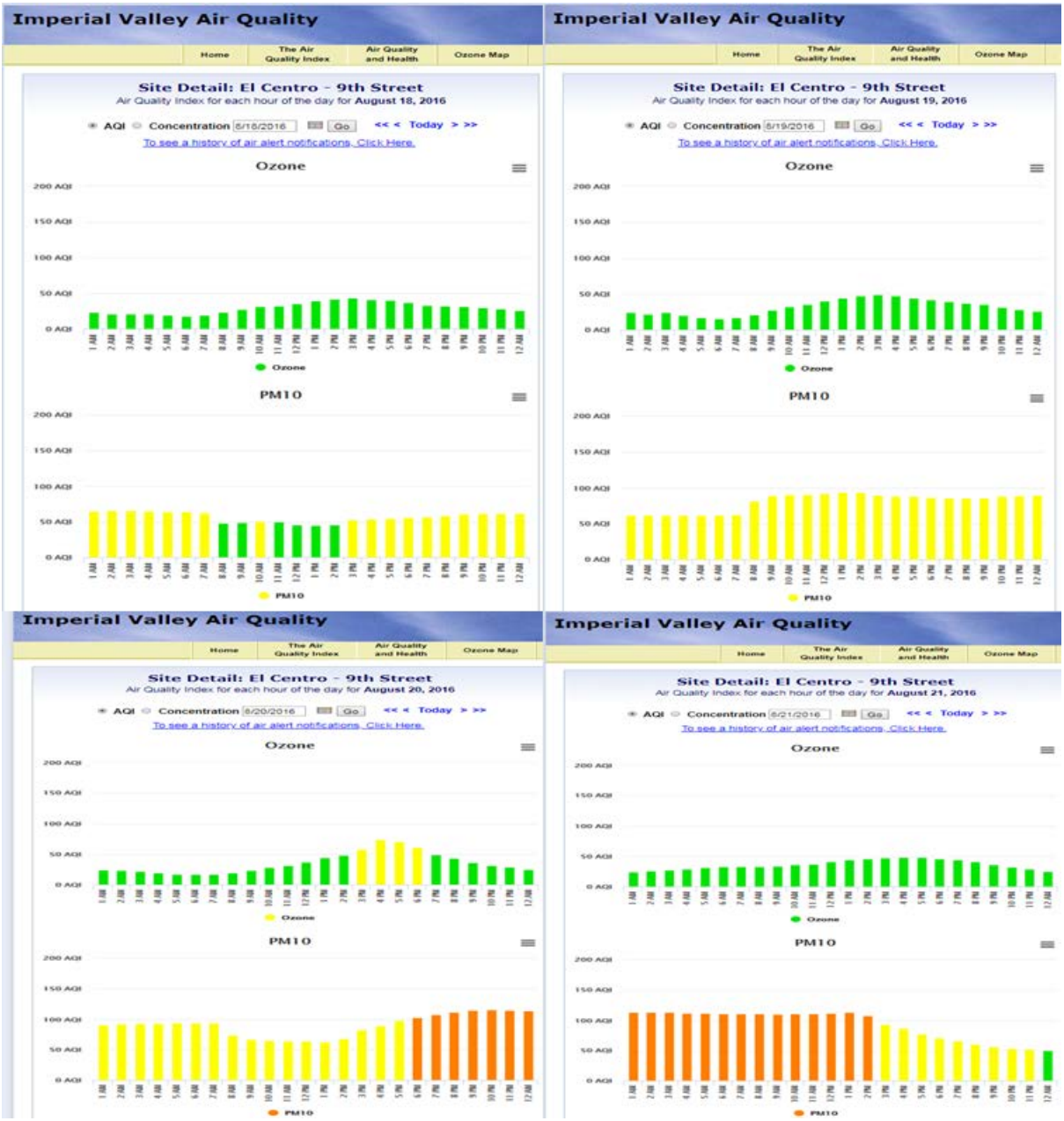


Fig 5-27: Reduced air quality is evident when warning go from Good or "Green" to Moderate or "Yellow" and Unhealthy for Sensitive Groups or "Orange". The top green hourly bars are for Ozone the bottom "Yellow" and "Orange" hourly bars are for PM_{10}. Source: ICAPCD archives

V.2 Summary

The preceding discussion, graphs, figures, and tables provide wind direction, speed and concentration data illustrating the spatial and temporal effects caused by the uncommon monsoonal intrusion of moisture, development of short-lived thunderstorms and associated erratic winds that affected Imperial County August 18, 2016 through August 21, 2016. The information provides a clear causal relationship between the entrained windblown dust and the PM_{10} exceedance measured at the Brawley, Westmorland and El Centro monitors on August 19, 2016 and August 21, 2016. Furthermore, the advisories and air quality index illustrate the effect upon air quality within the region extending from the southwest portion of Yuma County, Arizona, all of Imperial County, and the southern portion of Riverside County. Large amounts of coarse particles (dust) and PM_{10} transported by outflow boundary gusty winds created by short-lived thunderstorm activity affected a change in the air quality conditions within Imperial County. The windblown dust, which originated from as far as the natural open desert areas located within eastern Riverside County, western Arizona and northern Mexico, entered Imperial County and affected air quality. Combined, the information demonstrates that the elevated PM_{10} concentrations measured on August 19, 2016 and August 21, 2016 coincided with gusty erratic winds and that gusty southerly winds were experienced over the southern portion of Riverside County, southeastern San Diego County, all of Imperial County, and parts of Arizona.

FIGURE 5-28
AUGUST 19, 2016 AND AUGUST 21, 2016 HIGH WIND EVENT TAKEAWAY POINTS

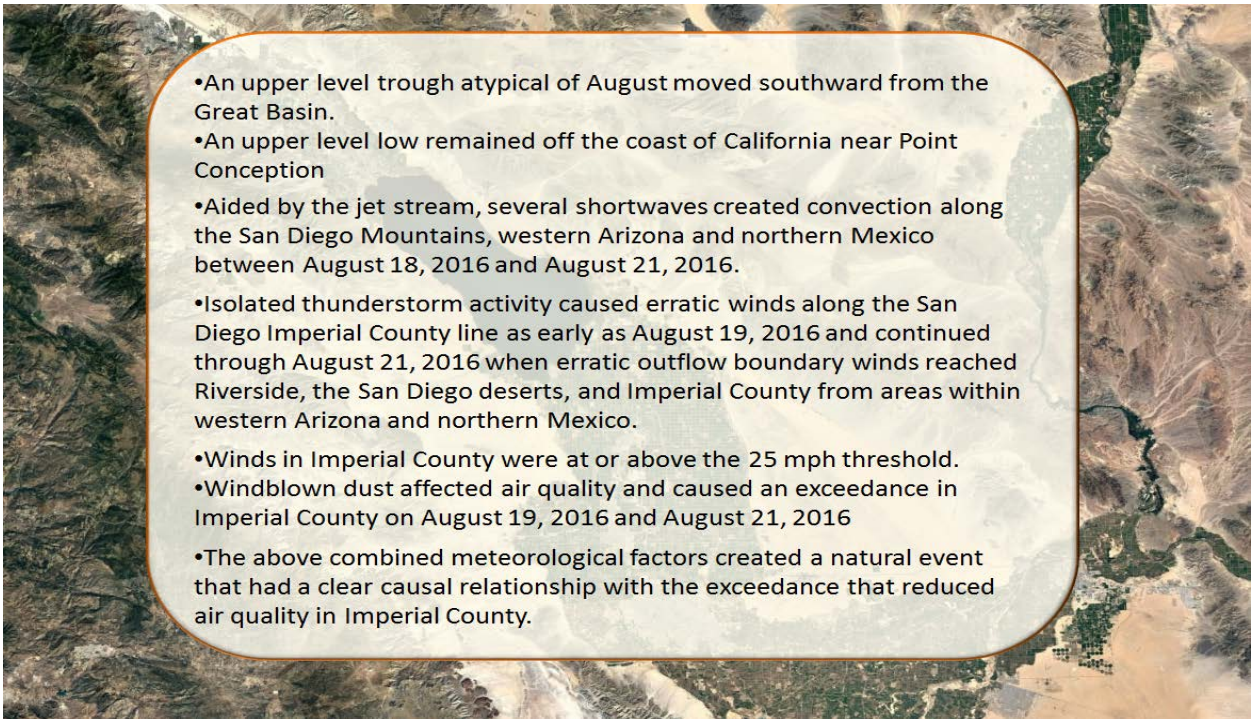


Fig 5-28: Is a summary of the meteorological conditions and facts that qualify the August 19, 2016 and August 21, 2016 event, which affected air quality as an Exceptional Event

VI Conclusions

The PM_{10} exceedance that occurred on August 19, 2016 and August 21, 2016, satisfies the criteria of the EER which states that in order to justify the exclusion of air quality monitoring data evidence must be provided for the following elements:

TABLE 6-1 TECHNICAL ELEMENTS CHECKLIST EXCEPTIONAL EVENT DEMONSTRATION FOR HIGH WIND DUST EVENT (PM_{10})		DOCUMENT SECTION
1	A narrative conceptual model that describes the event(s) causing the exceedance or violation and a discussion of how emissions from the event(s) led to the exceedance or violation at the affected monitor(s)	7-45; 103
2	A demonstration that the event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation	65-101; 102
3	Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times to support the requirement at paragraph (c)(3)(iv)(B) of this section	46-56; 103
4	A demonstration that the event was both not reasonably controllable and not reasonably preventable	57-64; 102
5	A demonstration that the event was a human activity that is unlikely to recur at a particular location or was a natural event	65-101; 102

VI.1 Affects Air Quality

The preamble to the revised EER states that an event is considered to have affected air quality if it can be demonstrated that the event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation. Given the information presented in this demonstration, particularly Section V, we can reasonably conclude that there exists a clear causal relationship between the monitored exceedance and the August 19, 2016 and August 21, 2016 event, which changed or affected air quality in Imperial County.

VI.2 Not Reasonably Controllable or Preventable

In order for an event to be defined as an exceptional event under section 50.1(j) of 40 CFR Part 50 an event must be "not reasonably controllable or preventable." The revised preamble explains that the nRCP has two prongs, not reasonably preventable and not reasonably controllable. The nRCP is met for natural events where high wind events entrain dust from desert areas, whose sources are controlled by BACM, where human activity played litter or no direct

causal role. This demonstration provides evidence that despite BACM in place within Imperial County, high winds overwhelmed all BACM controls where human activity played little to no direct causal role. The PM_{10} exceedance measured at the Brawley and Westmorland monitors were caused by naturally occurring strong gusty northeasterly winds from thunderstorms late on August 18 that transported fugitive dust into Imperial County from eastern Riverside County, and from southerly winds on August 19 that transported fugitive dust into Imperial County and other parts of southern California from areas located within the Sonoran Desert regions of northern Mexico to the south of Imperial County. These facts provide strong evidence that the PM_{10} exceedances at Brawley, Westmorland and El Centro on August 19, 2016 and August 21, 2016, were not reasonably controllable or preventable.

VI.3 Natural Event

The revised preamble to the EER clarifies that a "Natural Event" (50.1(k) of 40 CFR Part 50) is an event and its resulting emissions, which may recur at the same location where anthropogenic sources that are reasonably controlled are considered not to play a direct role in causing emissions, thus meeting the criteria that human activity played little or no direct causal role. As discussed within this demonstration, the PM_{10} exceedance that occurred at the Brawley, Westmorland and El Centro monitors on August 19, 2016 and August 21, 2016, were caused by windblown dust caused by thunderstorm outflows associated with an active storm environment. At the time of the event anthropogenic sources were reasonably controlled with BACM. The event therefore qualifies as a natural event.

VI.4 Clear Causal Relationship

The time series plots of PM_{10} concentrations at Brawley and Westmorland, and the comparative analysis of different areas in Imperial and Riverside county monitors demonstrates a consistency of elevated gusty west winds and concentrations of PM_{10} at the Brawley, Westmorland and El Centro monitoring stations on August 19, 2016 and August 21, 2016, (Section V). In addition, these time series plots and graphs demonstrate that the high PM_{10} concentrations and the gusty southerly winds were an event that was widespread, regional and not preventable. Arid conditions preceding the event resulted in soils that were particularly susceptible to particulate suspension by the elevated gusty west winds. Days immediately before and after the high wind event PM_{10} concentrations were well below the NAAQS. Overall, the demonstration provides evidence of the strong correlation between the natural event and the entrained fugitive emissions to the exceedances on August 19, 2016 and August 21, 2016.

VI.5 Historical Concentrations

The historical annual and seasonal 24-hr average PM_{10} values measured at the Brawley and Westmorland monitors were historically unusual compared to a multi-year data set (Section III).

Appendix A: Public Notification that a potential event was occurring (40 CFR §50.14(c)(1))

This section contains forecasts and a dust storm alert issued by the National Weather Service for Imperial County on or around August 19, 2016 and August 21, 2016. The data show a region-wide increase in wind speeds and wind gusts coincident with the arrival of dust and high PM_{10} concentrations in Imperial County.

Appendix B: Meteorological Data.

This Appendix contains the time series plots, graphs, wind roses, etc. for selected monitors in Imperial and Riverside counties. These plots, graphs and tables demonstrate the regional impact of the wind event.

Appendix C: Correlated PM_{10} Concentrations and Winds.

This Appendix contains the graphs depicting the correlations between PM_{10} Concentrations and elevated wind speeds for selected monitors in Imperial and Riverside counties. These graphs demonstrate the region wide impact of the wind event.

Appendix D: Regulation VIII – Fugitive Dust Rule.

This Appendix contains the compilation of the BACM adopted by the Imperial County Air Pollution Control District and approved by the United States Environmental Protection Agency. A total of seven rules numbered 800 through 806 comprise the set of Regulation VIII Fugitive Dust Rules.